Power Engineering

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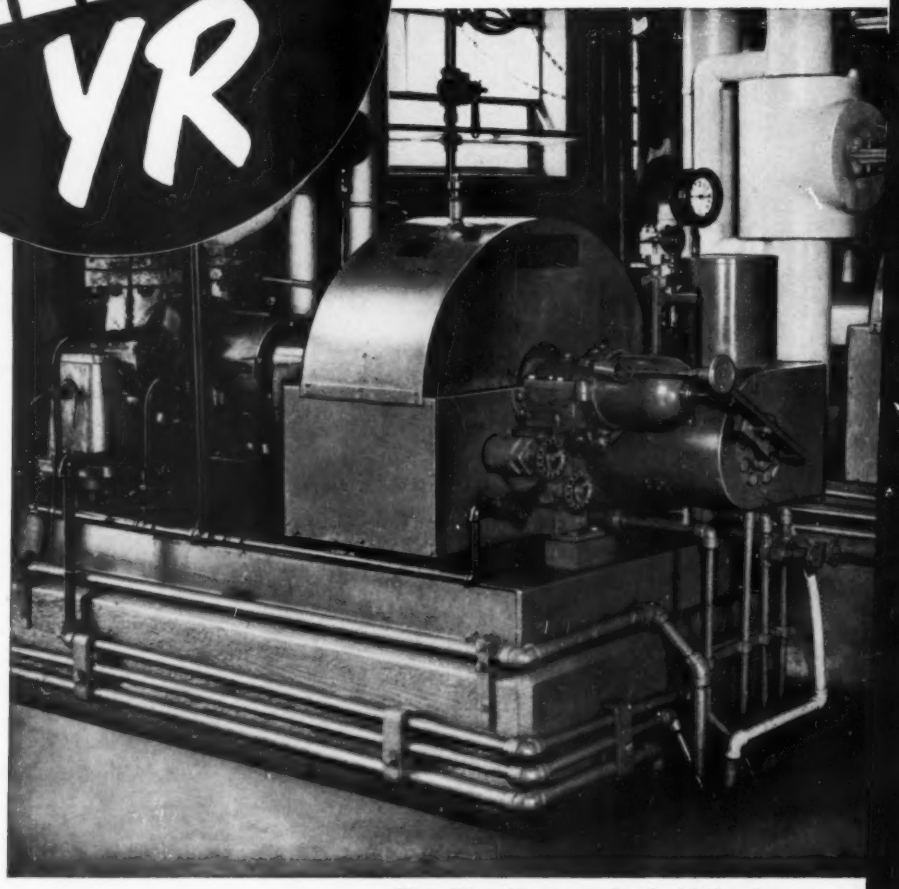
ELLIOTT YR *the Turbine*



Elliott YR turbines may be furnished, when so specified, with carefully tailored, neat appearing, and readily removable jacketing, as in this installation.

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2 RELIABILITY— Here is a quality for which Elliott turbines have long been renowned. In the YR, this quality has been further enhanced by improving manufacturing facilities and details of design upon which reliable operation depends.

3 ECONOMY— Added to the operating saving in using a turbine practically built for its specific conditions, is the further direct saving in the reduction in stocking replacement parts due to the interchangeability of wearing parts on all frame sizes. One of the benefits of standardization.

4 REPUTATION— The high standing which Elliott turbines have earned everywhere is the best safeguard an engineer can have to sustain his selection of YR turbines. As one engineer said to another who had been having drive troubles, "Why don't you put in Elliott turbines and stop worrying?" In this he voiced an opinion almost universally held.

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M-729

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Power Engineering

Combining POWER PLANT ENGINEERING and POWER GENERATION

This magazine was established in 1896 as Practical Engineer. The title was changed to POWER PLANT ENGINEERING in 1918, to POWER GENERATION in 1948, and to POWER ENGINEERING in May, 1950. Rights reserved to above titles

November, 1951

VOLUME 55 — NUMBER 11

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How to Buy Coal and Evaluate Its Quality 56

by Fred M. Reiter

Last February we published a study of coal analyses from the standpoint of the user by Fred Reiter who is Materials Research Engineer of the Dayton Power & Light Co. at Dayton, Ohio. Now, we present another article by Mr. Reiter, this time on methods of purchasing coal. This tells engineers how to take advantage of different sources of supply and discusses methods of weighing the value of one source against another.

Electrical Features of Bokaro Station 61

by Hrand H. Levonian

Continuing the description of Bokaro Station in the October issue, this article considers the electrical features of this new 150,000 kva station in India.

Internally Cooled Coils Boost Generator Ratings 62

by C. M. Laffoon

Here is an interesting article on a new method of electric generator construction which makes it possible to build single-shaft, 3600 rpm machines of 200,000 kw and larger.

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Take a Walk Through Your Power Plant 66

with David Moffat Myers

In reading this article you take an imaginary trip through your own power plant with a famous consulting engineer and listen to him suggest ways of improving performance of various pieces of equipment.

Keep Pump Cavitation Down 68

Bruce R. Walsh

This article tells what the engineer who installs, operates and maintains pumps can do to minimize pump cavitation, especially in reciprocating and rotary pumps. Incomplete filling of pump, leading cause of cavitation, caused by incorrect suction conditions.

Progress Report—Baldwin-Westinghouse Gas-Turbine Electric Locomotive 70

by T. J. Putz

Here's the latest news about the Baldwin locomotive powered by a Westinghouse gas turbine. It is now in operation on the Pittsburgh and Lake Erie Railroad. It burns Bunker C fuel and its general operation has been good.

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Iceland Builds New Hydroelectric Plants Underground 87

This article shows how new underground plants are being built in Iceland. Most of the European underground plants are built that way because it is cheaper, their protection against bombing being an incidental advantage.

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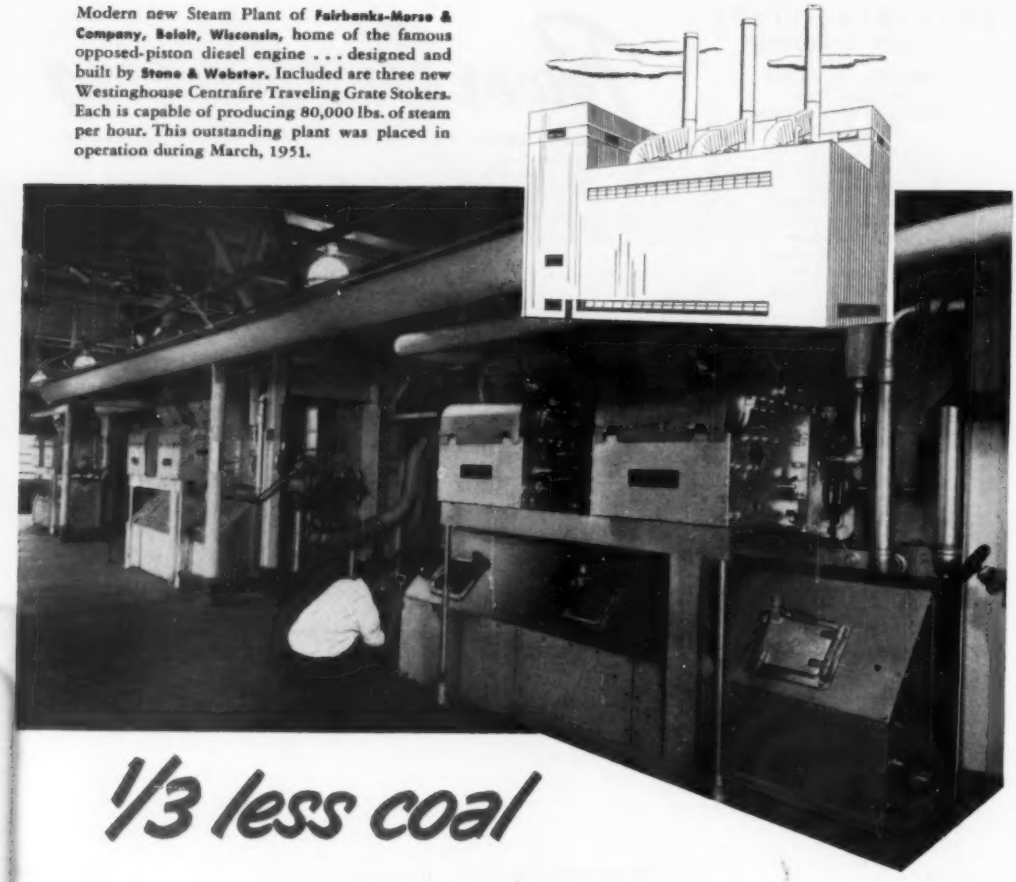
The only magazine devoted exclusively to the engineering interests and practical problems of power engineers

Modern new Steam Plant of **Fairbanks-Morse & Company, Beloit, Wisconsin,** home of the famous opposed-piston diesel engine . . . designed and built by **Stone & Webster.** Included are three new Westinghouse Centrafire Traveling Grate Stokers. Each is capable of producing 80,000 lbs. of steam per hour. This outstanding plant was placed in operation during March, 1951.



1/3 less coal

with same load

Three Westinghouse Centrafire® Stokers with Traveling Grate, installed at the new Fairbanks-Morse Steam Plant, are establishing an impressive record of efficient and economical operation. Previous stokers operating under identical temperature and load conditions burned approximately 50% more coal than now is required by the new Westinghouse Centrafire.

Each pound of coal now produces more steam due to more complete combustion with a minimum of excess air. Accelerated response to changing steam loads makes operation easy. Requirements for operating and maintenance personnel have been cut considerably.

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YOU CAN BE SURE...IF IT'S Westinghouse

STOKERS

ENGINEERS' PREVIEW

DO WE NOW have in sight enough new production of sulphur to solve the present free world sulphur shortage? If the latest report of discovery of a large new sulphur deposit at Garden Island Bay, La., bears out the present predictions, then we may have enough to solve the problem. For some time now, there has been a great deal of agitation in the chemical and in other industries about the sulphur shortage, which is directly related, of course, to the production of sulphuric acid used in so many other processes. A great many suggestions and plans for obtaining sulphur as a by-product from other processes and materials, such as coal, have been advanced to meet this situation. Sulphur demand exceeds the supply so much that its domestic use is restricted by the National Production Authority, exports are rigidly controlled and world supplies are allocated among nations by the International Raw Materials Conference.

The deposit recently discovered in Louisiana, as reported by AP, is in a salt dome formation of brimstone, cheapest and purest of the various forms of sulphur. The Freeport Sulphur Co., which discovered it, has announced plans to build a $10,000,000 to $15,000,000 mining plant at the deposit to produce 500,000 long tons of sulphur a year. The United States accounted for about 90 per cent of the world's crude sulphur last year — the low-cost form on which most industry users depend.

★ ★ ★

FIVE OR TEN years from now, the heat pump may be the next great residential load builder. If only 10 per cent of American homes could be equipped with it, present domestic load could be doubled. So claims General Electric Co. in announcing that production of standardized package units suitable for heat pump application is already under way, depending on the availability of manpower and materials. A number of pilot installations in various parts of the country have shown encouraging results. For example, in a moderate temperature zone with a power rate of 1.5 cents per kwh, a 3-hp heat pump should average only $135 per year for both heating and cooling a 6 room house. There are still problems to be solved, of course, but, as usual, the electrical industry will take them in its stride.

★ ★ ★

SEVEN-SIDED POST HOLES are not too common in the power industry. But you can become very familiar with this interesting hootenanny if you will read the little book just published by American Standards Association called The Strange Case of the Seven-Sided Post Hole. It points a moral. Its whimsical text and very clever and funny illustrations suggest the confusion and waste that exist when each manufacturer in an industry makes his product as different as possible. The booklet recounts the advantages gained by the Post Hole Industry when it agreed on voluntary standards, clearing them through the American Standards Association. The Post Hole Industry is imaginary, of course, but the advantages of standards are not, and the ASA has used this very clever little booklet to explain those advantages and how they can be obtained by a great many industries. You may obtain a copy of it from the American Standards Association, 70 East 45th St., New York 17, N. Y.

QUESTIONS AND ANSWERS on the Controlled Materials Plan are published in a 28-page booklet recently issued by National Production Authority. This gives the answers to a number of questions on the various problems that come up among manufacturers as to classification of their products, allocation of materials and allied questions. The booklet is available from the Office of Public Information, National Production Authority, U. S. Department of Commerce, Washington 25, D. C.

★ ★ ★

AS ADMINISTRATIVE sponsor for Sectional Committee B16 — Pipe Flanges and Fittings — the American Society of Mechanical Engineers announces the distribution, for letter ballot vote of the sectional committee, of the proposed American Standard on Nonmetallic Gaskets for Pipe Flanges, ASA B16.

This is tentative, subject to revision, and all engineers who wish to contribute to it or comment on the proposed standards may obtain copies of the tentative draft from D. M. Shackelford, Standards Department, The American Society of Mechanical Engineers, 29 W. 39th Street, New York 18.

★ ★ ★

PROCEDURE to be followed by an apprentice and his employer when the apprentice leaves to join the armed forces is clarified in a brief, illustrated pamphlet, issued by the U. S. Department of Labor's Bureau of Apprenticeship. It explains the records to be prepared for use by an apprentice when reporting for active duty and also for his use when he returns from military service so that he may be assured of reemployment rights. Copies from the Bureau of Apprenticeship, U. S. Department of Labor, Washington 25, D. C. When requesting copies, please mention the publication in which this notice appeared.

★ ★ ★

NEW ELECTROPLATING process, reported to offer the first practical approach for plating of aluminum, was announced at the fall meeting of The Electrochemical Society, October 9–12, 1951, at Detroit, Mich. Based on the use of non-aqueous solutions, the new method was developed by D. E. Couch and Abner Brenner of the U. S. Bureau of Standards, and was described by Dr. Couch during the symposium on electroplating processes at the meeting.

★ ★ ★

EVER SEE the stern half of a Swedish freighter going East? Well, the stern half of the Swedish freighter *Christer Salén*, which was wrecked and split in two in a typhoon off Yokohama last May, returned to Europe under its own power, to be rebuilt at Bremen. This was because repair costs in Japan were too high. A 40-ft makeshift prow was added to the stern half of the vessel in place of the 285 ft forepart lost in the gale. The crippled ship carried a full cargo and it was estimated that the trip would take two months with an average speed of 9 knots. At this writing we have not heard whether she made port or not. It reminds us of the way in which the citizens of Alaska took the afterpart of a vessel wrecked on the Alaskan coast and, by using the vessel's boilers and engines, which were installed near the stern, turned it into a stationary power plant, as chronicled in *Engineers' Preview* some time ago.

A ROCKET that could go to the Moon and other planets was termed a "marginal possibility" by a General Electric scientist in a recent address.

Speaking before the New York Section of the American Chemical Society, Anthony J. Nerad of the G-E Research Laboratory said that the greatest factor in making such extremely long distance rocket flight possible, with fuels now available, would be a rocket built in stages. Mr. Nerad, who is Assistant Manager of the laboratory's chemistry division, said there would be several sections, which would drop off one by one after fuel is used.

However, the scientist warned, still more development is required to make such rockets a reality. Even by taking advantage of all known techniques to extract from propellants the best possible performance, we still "have not attained the real margins needed for very long-range terrestrial rockets or those which we can send to the planets," Mr. Nerad said.

"We thus come to a stopping point," he pointed out, "where we must consider admitting that our future lies in the use of atomic fuel, or else we must conceive of an easier or necessary intermediate step."

★ ★ ★

SEMINAR ON OPERATIONS RESEARCH in Industry and Business, first of its kind, will be held by the Department of Engineering Administration at Case Institute of Technology, from Nov. 8, to 10. Experts who will participate in the seminar include Dr. Horace C. Levison, chairman of the National Research Council Committee on Operations Research; Dr. Sebastian B. Littauer, associate professor of industrial engineering, Columbia University; Dr. C. West Churchman, operations research professor, Case Institute of Technology; Dr. Philip M. Morse, professor of physics, Massachusetts Institute of Technology, and David B. Hertz, assistant professor of industrial engineering, Columbia University.

Objective of the seminar is to explore the areas of greatest potential commercial value for the application of operations research techniques in industry and business. Topics to be discussed will include: how operations research works, how it can serve particular needs more efficiently than traditional research methods, use of sampling methods with respect to operations research, the future of operations research in business and industry, and how to direct and administer operations research. Full information from Douglass W. Miller, Case Institute of Technology, Cleveland 6, Ohio.

★ ★ ★

SAWDUST a practical food for cattle? Well, experiments in the G-E Research Laboratory, in collaboration with the department of bacteriology at the State College of Washington, Pullman, Wash., show that irradiation with high-voltage electrons, or cathode rays, makes part of the sawdust digestible by organisms in the cow's stomach.

Wood consists largely of cellulose, combined with another compound called lignin, in which combination it is indigestible.

The cathode rays make the cellulose available. Bacterial action in the rumen, the first of the cow's four stomachs, is able to convert the cellulose into several other compounds, such as acetic, propionic and butyric acids. These are generally known as the volatile acids, and can be absorbed in the animal's intestines.

Basswood was used in the experiments, both in the form of sawdust and small wafers. It was irradiated in the Research Laboratory by a modification of the million-volt X-ray unit.

BLAST FURNACES making essential ferromanganese for this country's record breaking steel output now can be prevented from giving off a dense fume to pollute the atmosphere. Control of air pollution by furnaces making ferromanganese is vastly different from the control needed to clean gas from furnaces making pig iron. United States Steel Co. laboratory tests were conducted to determine methods that would remove the very fine fume which makes up 80 per cent of the impurities in the gas from a ferromanganese furnace. It was found that this foreign matter could be removed by spraying the dirty gas with water, precipitating the fume electrically, burning it and pressing it into briquettes. The latter measure was thought necessary to prevent the collected dust from being blown away by the wind during disposal. In a pilot plant, no fume at all was discernible. As a result of this work, a plant has been designed to clean 135,000 standard cfm of ferromanganese blast furnace gas.

★ ★ ★

EVERY reader of POWER ENGINEERING should be interested in what happens to electricity when the consumer gets hold of it. We have been wondering lately how many engineers have thought through the implications of the recent television test conducted here in Chicago. Three hundred families were equipped with television sets capable of receiving controlled programs of movies, for which they paid a fee. According to our information, 90 per cent of the subscribers, after one month's trial of this system, said they preferred to see the entertainment in their own homes rather than going to theaters for it.

It might be worth while to give a little thought to the effect of this on the transportation industry, the parking lot industry, the hot dog and pop-corn industry, also the effect of it on the home lighting load, the consumption of ice cubes and other uses, to say nothing of the power used in the television sets themselves.

In one large city, during the recent television broadcasts of the Senate Crime Committee investigations, we were informed by the head of the local utility that it was necessary to put a big turbine generator on the line during the day just to carry the increased television set load.

★ ★ ★

ELECTRICAL EQUIPMENT, specially designed to power the 2,000,000,000 electron-volt Cosmotron has successfully passed its first tests at the Brookhaven National Laboratory, Upton, N. Y.

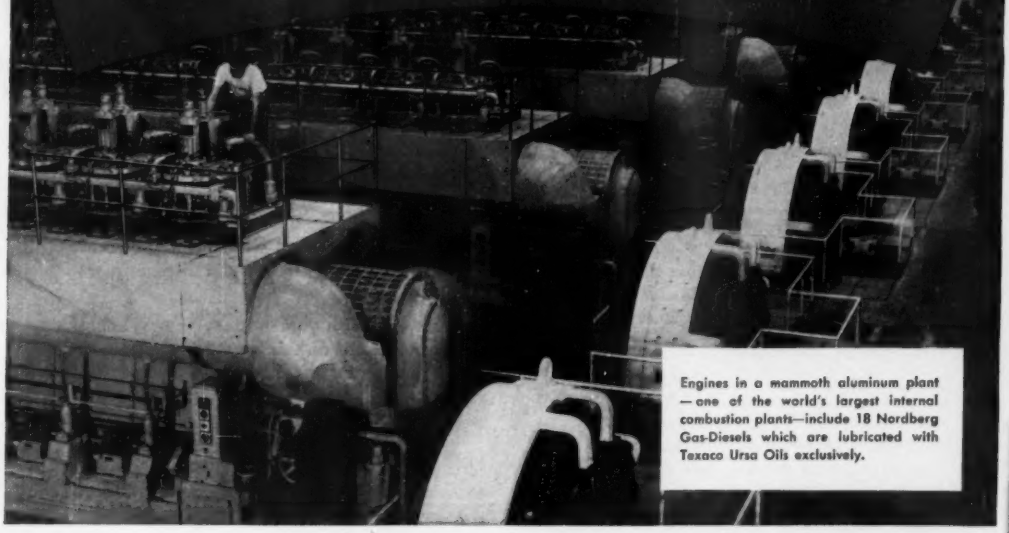
This was disclosed with the announcement by the Laboratory that the 2200-ton magnet — key component of the accelerator — has been tested at its full power of 40,000 kw. Other elements are now being added and the complete machine should be ready for trial runs early next year. It was built by Westinghouse.

Called the "Cosmotron" because it will give atomic particles energies equal to some cosmic rays, the giant machine is designed to accelerate protons to energies five times greater than those provided by the largest existing cyclotron. The electrical equipment will feed power to the ring-shaped iron magnet, 65 ft in diameter, which contains an acceleration chamber for the protons.

The energy is supplied by a large motor-generator set, equipped with a 45-ton flywheel, that delivers alternating current to a battery of 24 ignitron rectifiers. These rectifiers convert the alternating current into 40,000-kw direct-current pulses. Twelve pulses per minute are sent into the Cosmotron magnet to guide the sub-atomic particles around the acceleration chamber.

YOU CAN REDUCE
fuel consumption

YOU CAN REDUCE
maintenance costs



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The Type "M" Illuminator is specially-designed to give maximum brilliance to Yarway flat glass inserts, and to spot the water level over its entire traverse. The superior penetration of its blue-white light cuts through extraneous light, dust particles in the air, and deposits on the gage glasses. Effective over longer distances.

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Get in touch with your nearest Yarway office for further details on this latest Flat Glass Gage development, or write direct to . . .

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A COMPLETE YARWAY WATER LEVEL SYSTEM

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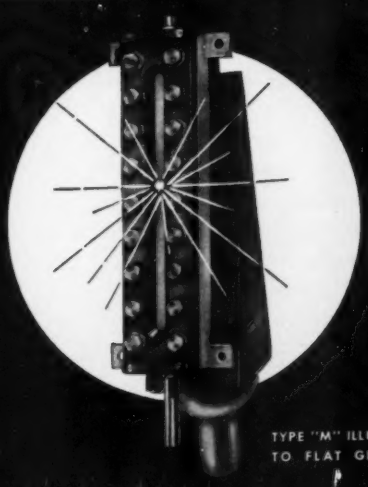
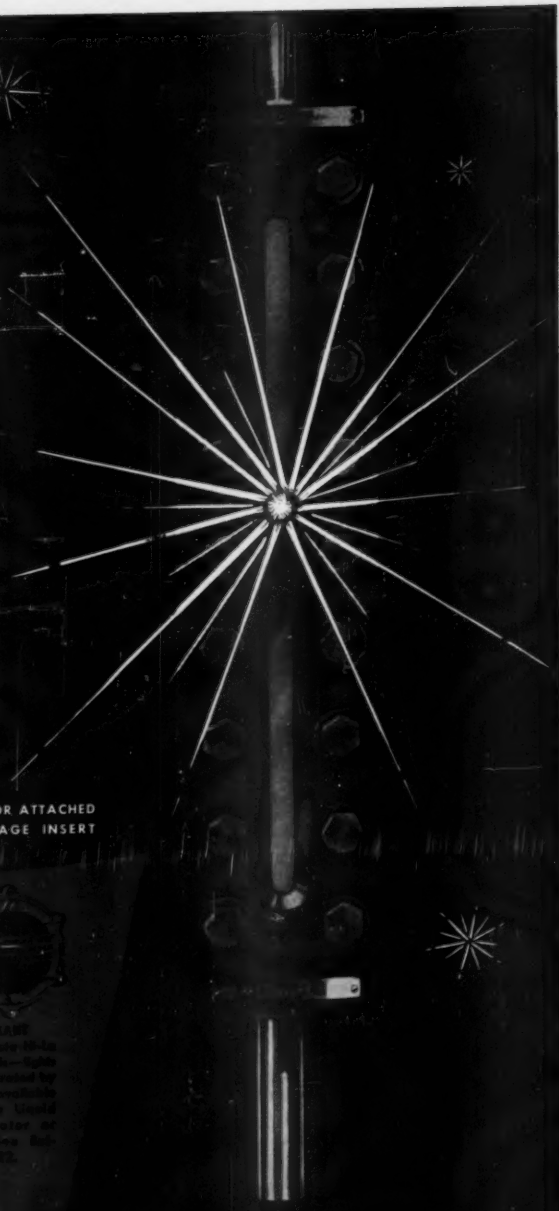
like a Star



TYPE "M" ILLUMINATOR ATTACHED
TO FLAT GLASS GAGE INSERT

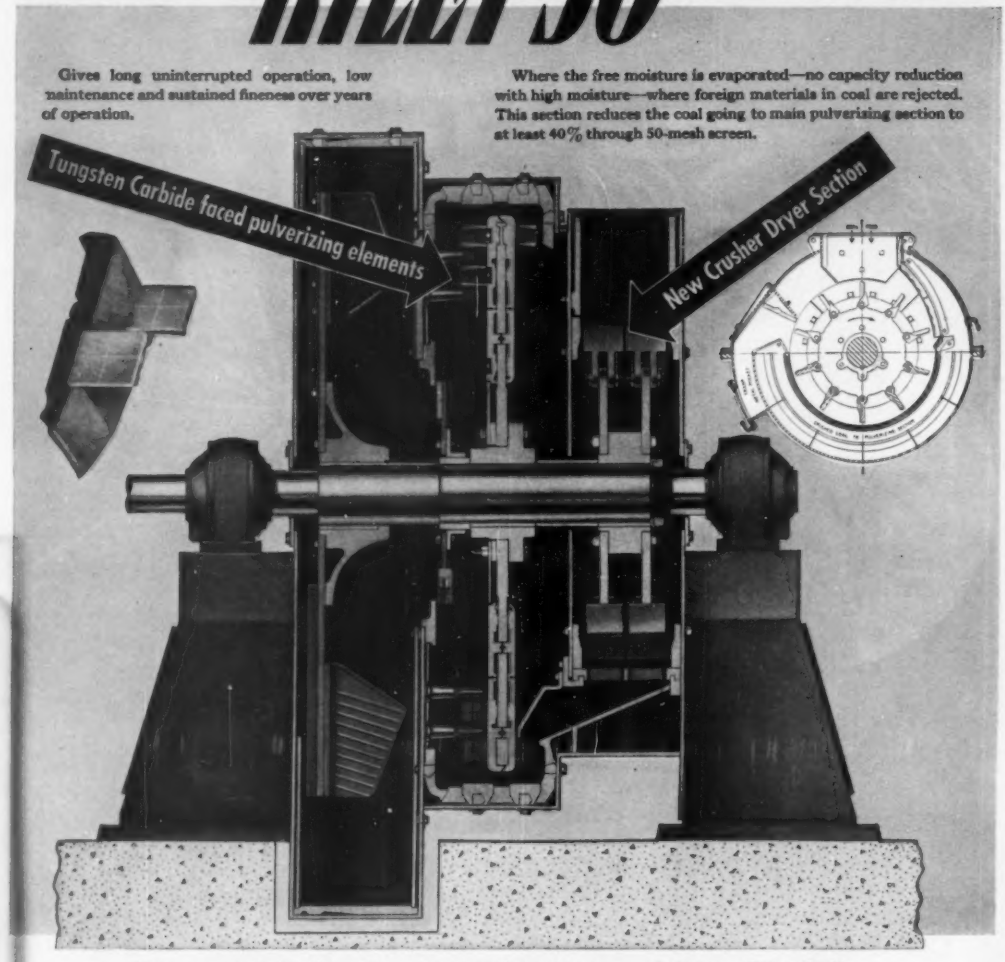


PLANT EQUIPMENT

The New "RILEY 50" Pulverizer

Gives long uninterrupted operation, low maintenance and sustained fineness over years of operation.

Where the free moisture is evaporated—no capacity reduction with high moisture—where foreign materials in coal are rejected. This section reduces the coal going to main pulverizing section to at least 40% through 50-mesh screen.



We can merely touch on the many operating advantages of the new Riley "50" pulverizer in a two-page ad. The Riley "50" is the most significant pulverizer development in the past decade. Write for the story of the Riley "50." It will pay you to thoroughly investigate the Riley "50" before purchasing coal pulverizers.

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Spontaneously Accepted by Engineers

Because of These Outstanding Features

*1 No capacity reduction with increase in moisture.

2 Tramp iron, iron pyrites and other foreign materials in coal rejected.

*3 Pulverizing elements faced with tungsten carbide.

4 Fineness sustained over years of operation.

5 Long periods of operation without necessity of shutdowns.

*6 Unusually high capacity per unit of space.

*7 Minimum foundation requirements.

*8 Ability to carry low loads.

9 Flexibility-wide load range.

*10 Operates without coal, with no noise and without wear or damage to parts.

11 Low maintenance and power.

*12 No explosion hazard, travel of coal through pulverizer faster than flame propagation.

*13 Quiet vibrationless operation.

*14 Ease of lighting and regulation.

15 High primary air temperatures.

16 Thoroughly dependable.

*17 Negligible cost of lubrication.

*18 All moving parts on a single horizontal shaft with bearings outside of housing. No worms or gears.

*19 Primary air fan integral with pulverizer —separate fan and motor not required.

No other pulverizer can approach the Riley "50" in these important characteristics.

All of these companies have ordered Riley "50" Series pulverizers within the past year

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*Iowa Electric Light & Power Co.
Utah Power & Light Co.
*Northern States Power Co.
*The Potomac Edison Co.
*Superior Water, Light & Power Co.
Central Ohio Light & Power Co.
*City of Owensboro, Ky.
City of Austin, Minn.
*Corn Belt Power Co-operative
*Public Service Co. of Colorado
Hartford Electric Light Co.

Industrial Plants

St. Croix Paper Co.
Hooker Electrochemical Co.
*Pittsburgh Plate Glass Co.
Celanese Corp. of America
United States Steel Co.
*Western Electric Co.
*Continental Can Co.
Monsanto Chemical Co.
Northern Paper Mills
Bell Aircraft Corp.
Syracuse University
Riegel Textile Corp.
Owens Corning Fiberglas Co.
*U.S. Finishing Co.
*Ciba States, Ltd.
*East Newark Realty
Lawless Brothers Paper Co.

These companies have never previously used Riley pulverisers. The other companies have repeatedly ordered Riley pulverisers.

These contracts were engineered by the following consultants

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Ebasco Services
Chas. T. Main, Inc.
Pioneer Service & Engineering Co.
Sargent & Lundy
Sanderson & Porter
Stone & Webster Engineering Corp.
Black & Veatch
United Engineers & Constructors
Stanley Engineering Co.
Kenneth R. Warrington
J. V. Edeskuty
Francisco & Jacobus
Douglas M. McBean
Robson & Woese, Inc.

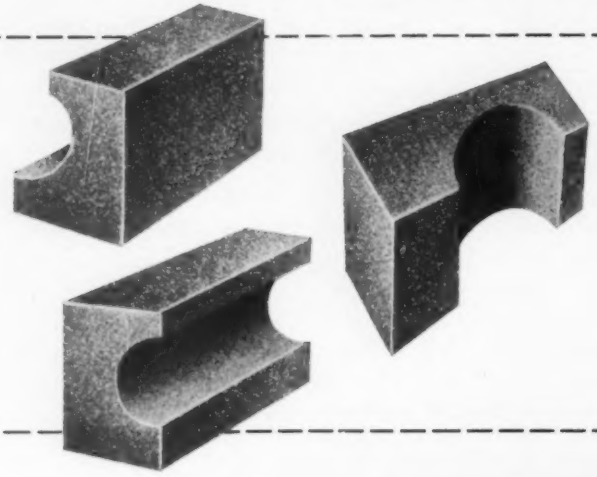
A survey of your Power Plant by a consulting engineer will possibly show ways of making surprisingly large savings in your power costs

COMPLETE STEAM GENERATING UNITS

. . . it will pay you to visit modern Riley Installations before purchasing Boiler or Fuel Burning Equipment

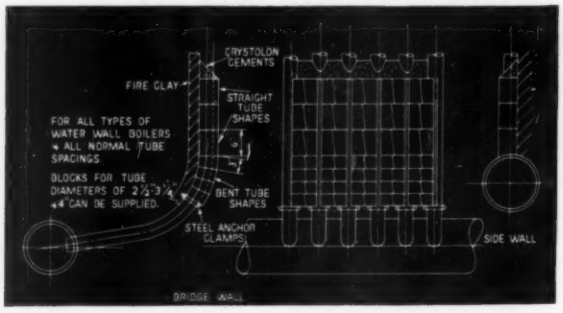
ECONOMIZERS • WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • AIR HEATERS

LASTING, LOW-COST PROTECTION
for Your Water Tube Boilers
with CRYSTOLON* Armor Blocks



Made Of Top-Quality Silicon Carbide, Norton CRYSTOLON Armor Blocks have the necessary refractoriness to withstand today's extremely high boiler furnace temperatures. Equally important is their high resistance to slag penetration and abrasion. Due to their high thermal conductivity, they promote even heat distribution, and afford maximum protection to tubes from localized heat generation and flame impingement.

Installation Is Easy And Inexpensive, thanks to the simplified design of CRYSTOLON Armor Blocks. Adjoining surfaces of blocks are tapered, for secure locking and to maintain intimate contact with the tubes. Available for both bent and straight tube sections, these blocks can be replaced entirely from the fire side of the boiler. They are laid dry, further reducing installation costs, and tubes require no cleaning or grinding, as when cast iron blocks are replaced. When small areas are to be protected against flame impingement, blocks can be held correctly in place by clamps fitted around the tubes.


CRYSTOLON CEMENTS
FIRE CLAY
STRAIGHT TUBE SHAPES
FOR ALL TYPES OF WATER WALL BOILERS + ALL NORMAL TUBE SPACINGS
BLOCKS FOR TUBE DIAMETERS OF 2 1/2" TO 4" CAN BE SUPPLIED.
BENT TUBE SHAPES
STEEL ANCHOR CLAMPS
SIDE WALL
BRIDGE WALL

Whatever type or make of water tube boilers you're using, you can depend on CRYSTOLON Armor Blocks for thorough protection and economy. For prices and full information, send data on tube diameters, tube spacing, radius of curvature in bent-tube sections, and dimensions of areas to be covered. Refractories Division, NORTON COMPANY, 616 New Bond Street, Worcester 6, Mass.

*Trade-Mark Reg. U. S. Pat. Off. and Foreign Countries

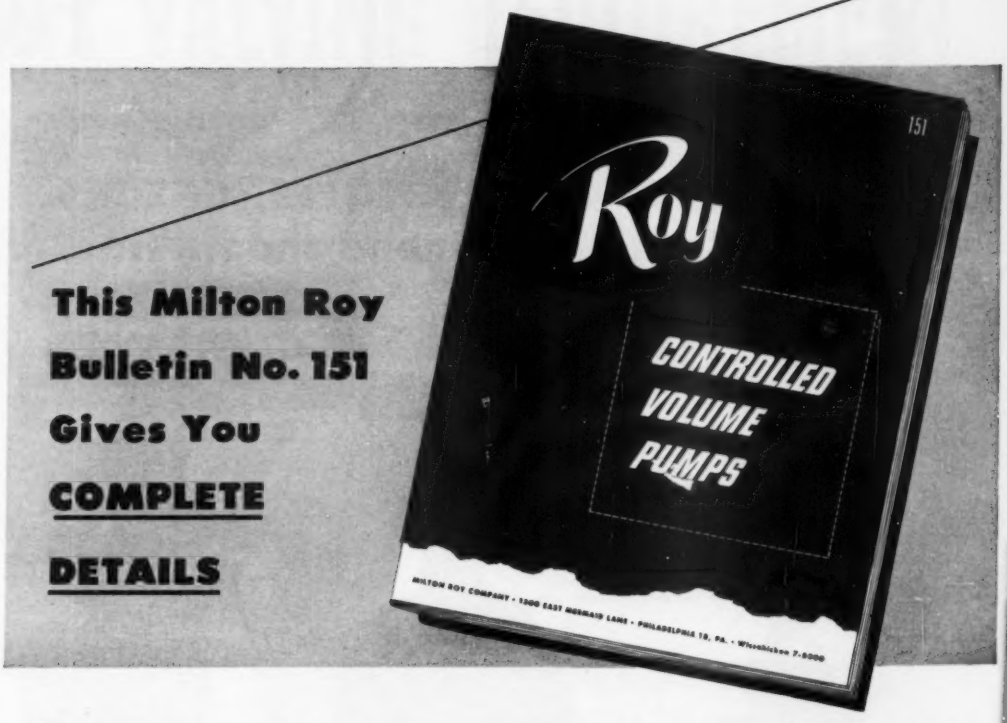
NORTON

Special REFRACTORIES

Making better products to make other products better

Canadian Representative
A. P. GREEN FIRE BRICK CO., Ltd. TORONTO, ONTARIO

CONTROLLED VOLUME PUMPING



Bulletin No. 151 is filled with information on controlled volume pumping. Here are a few of the many important details you'll find in the book:

- an explanation of controlled volume pumping.
- a description of what controlled volume pumping can do for you—what it does for others in the chemical, textile, petroleum, pulp and paper, paint, food and beverage, water treatment, pharmaceutical, and brewing industries and in instrumentation, pilot plants and laboratories.
- a description of how Milton Roy Controlled Volume Pumps give users maximum benefits; how any desired rate of delivery, from zero to full capacity, can be maintained with accuracy; how deliveries as low as 3 milliliters per hour can be held with precision; how difficult-to-pump materials, such as slurries, viscous liquids, solids in suspension, etc., are readily handled.
- 4 pages of color charts which show in dramatic "traffic-light" style the relative corrosion resistance of materials of construction to over 170 chemicals. These valuable reference charts summarize industry-wide data.
- a description of the features that make Milton Roy Controlled Volume Pumps perform flawlessly on services where no other pump has filled the need.

If your operations call for pumping a controlled volume of liquid in amounts as much as 50 gallons per *minute* or as little as 3 milliliters per *hour*, you'll find this book extremely valuable.

For your free copy of the 24-page, 2-color Milton Roy Bulletin No. 151, write or call the Milton Roy representative listed in your telephone directory. Or, if you prefer, write direct to us.

WITH THE EXCLUSIVE STEP-VALVE DESIGN

MILTON Roy COMPANY

1320 EAST MERMAID LANE, PHILADELPHIA 18, PA.

MANUFACTURERS OF CONTROLLED VOLUME PUMPS AND AUTOMATIC CHEMICAL FEED SYSTEMS

OIC FOR

GATES, GLOBES, ANGLES, CHECKS
There's this long line to choose from . . .

BRONZE

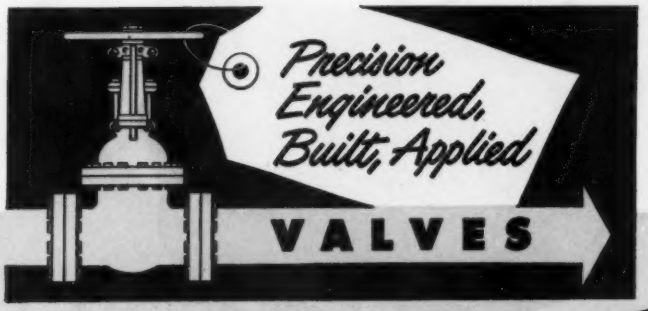
⅛-inch to 3-inches
125S, 150S, 200S, 300S, 350S, 300A, 200, 400, 2000 & 2500WOG.

IRON

1¼-inch to 16-inches
125S, 150S, 250S, 175, 200, 400 & 500 WOG.
CLIP GATES—¼-inch to 4-inches.

OIC
FOUNDED 1883

ANY VALVING REQUIREMENT



FORGED STEEL

¼-inch to 2-inches
600 primary pressure series.

CAST STEEL

2 inches to 16 inches
150, 300 and 600 primary pressure series.

Screwed, flanged, butt weld and socket weld ends . . . rising and non-rising stems . . . outside screw and yoke . . . alloy metal seats, discs and wedges, composition discs . . . union, inside screw and bolted bonnet . . . tapered and parallel seat wedges.

If you're needing valve application know-how, call the nearby OIC distributor or write direct to us. The Ohio Injector Company, Wadsworth, Ohio.

VALVES

FORGED AND CAST STEEL • IRON • BRONZE

New

SAVES WATER and CUTS MAINTENANCE COSTS . . .

Illustration shows two views of a 35 ton Condenser Tower prior to partial disassembly for shipment.

Vogt

CONDENSER TOWER

FOR CONDENSING REFRIGERANTS

SINGLE RESPONSIBILITY:

Vogt, leading builder of refrigeration condensers, assumes responsibility for engineering the unit. Only one purchase order needed.

SHOP FITTED:

To cut down field assembly labor. Requires no cutting or fitting of pipe.

Designed for today's water conservation requirements, and to keep refrigeration costs low, the *new* Vogt Condenser Tower meets the need for a proven, readily cleanable condensing unit.

The Vogt Condenser Tower consists of a multipass straight tube condenser, a receiver, an oil trap, a cooling tower, and a water pump. Removable cast iron heads permit easy cleaning of the condenser tubes.

Water costs are extremely low since the cooling water is recirculated continuously and requires only a small amount of makeup to replace losses due to windage and evaporation.

Condenser Tower units are available in capacities ranging from 5 to 50 tons refrigeration. Additional information will be furnished upon request.

HENRY VOGT MACHINE CO., Louisville 10, Kentucky

BRANCH OFFICES: NEW YORK, PHILADELPHIA, CLEVELAND, CHICAGO, ST. LOUIS, DALLAS, CHARLESTON, W. VA.

IT ALWAYS PAYS TO SPECIFY

LADISH

Controlled Quality

PIPE FITTINGS

TO MARK PROGRESS

...where flow efficiency is a vital factor

You can depend on Ladish Controlled Quality Fittings to maintain maximum flow characteristics of any piping system . . . and do it consistently year after year. For advanced Ladish engineering assures the true circularity, full effective radii and smooth inner surfaces necessary to keep turbulence and friction loss at a minimum . . . features which are doubly safeguarded by the high, inflexible standards of Ladish Controlled Quality.

THE COMPLETE *Controlled Quality* FITTINGS LINE
PRODUCED UNDER ONE ROOF...ONE RESPONSIBILITY

LADISH CO.

CUDAHY, WISCONSIN
MILWAUKEE SUBURB

District Offices: New York • Buffalo • Pittsburgh • Philadelphia • Cleveland • Chicago • St. Paul
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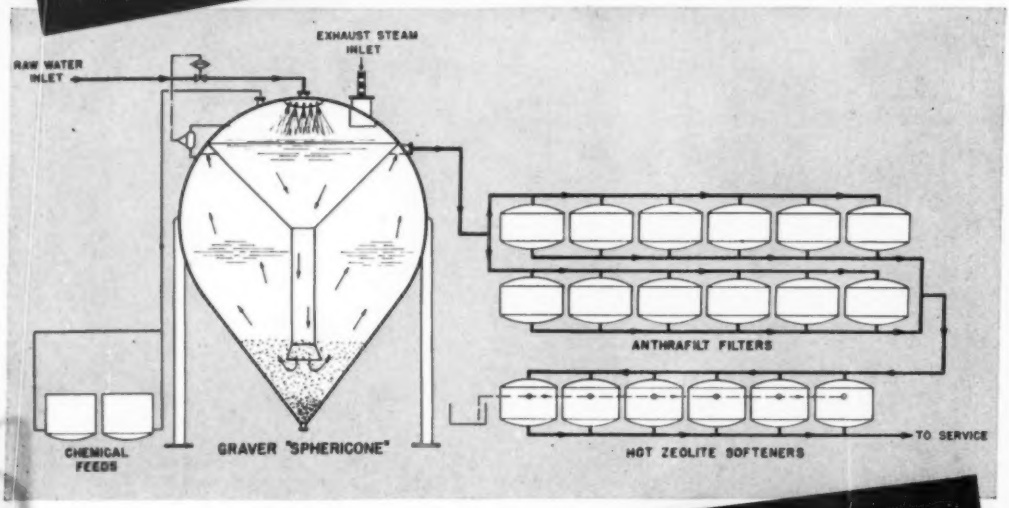
World's Largest HOT PROCESS- Hot Zeolite Plant



When a large eastern refinery wanted the most modern, efficient and economical treating system to handle 200,000 gph of feedwater ... virtually 90 to 100% make-up ... for their 650 psig boilers, their engineers selected a GRAVER Hot Process-Hot Zeolite plant employing GRAVEX styrene zeolite.

Advantages of this type of Water Conditioning System

This Graver water treatment with hot zeolite was chosen because it offered these advantages over a hot process softener with hot phosphate after-treatment:

1. **Lower hardness in feedwater.**
2. **Lower CO_2 in steam because of lower alkalinity.**
3. **Lower chemical operating costs.**
4. **Low silica in feedwater.**
5. **A uniformly low hardness in feedwater with possible rapid variations in raw water composition.**

The plant includes a single GRAVER SPHERICONE Hot Process Sedimentation Tank ... also the largest in the world ... to handle the entire water supply. This exclusive tank design gives greatest clarity of effluent, and at the same time provides greatest economy in steel and manufacturing cost. • **Write for further information on the application of this type of GRAVER Water Conditioning System to your own feedwater needs.**

BY GRAVER

Facts about the GRAVER equipment in this plant

- One GRAVER SPHERICONE Hot Process unit 43 ft 6 in dia x 60 ft high.
- Six GRAVER Hot Zeolite Softeners, each 10 ft dia x 5 ft 6 in high.
- Twelve GRAVER Anthrafilt Filters, each 11 ft dia x 5 ft high.
- GRAVER Chemical Feeders.

●●●●●

Write for Technical Articles: "Hot Zeolite Softening" and "Factors in Hot Process Softener Design and Operation."

GRAVER

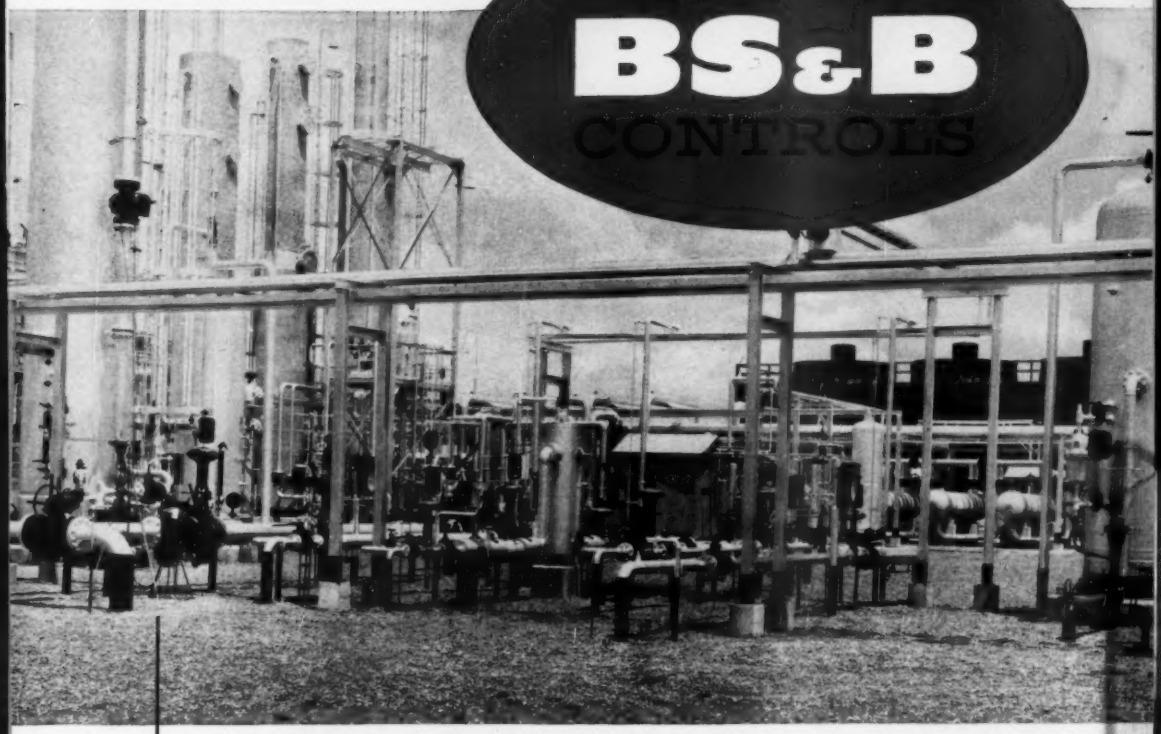
GRAVER WATER CONDITIONING CO.
Division of Graver Tank & Mfg. Co., Inc.
216 WEST 14th STREET, NEW YORK 11, N. Y.

GW 433 A

WHEREVER ACCURACY COUNTS...

You Can Count on...

CLIMAX
BS&B
CONTROLS



SUN OIL COMPANY'S big, modern Natural Gas plant at Delmita, Starr Co., Texas — where 99% of the automatic valves and controls are Climax.

For control of pressures, temperatures, levels and flow—industries look to Climax Controls for the exacting reliability they require.

Accuracy is initiated at the BS&B Climax Controls division, where every control and valve must undergo rigid tests before delivery; and where engineers, metallurgists and laboratory technicians are constantly exploring and developing new materials, new methods, new and improved products, and new ideas.

In the Oil, Gas, Chemical and Petro-Chemical Industries, especially, the name "Climax" has become synonymous with efficiency and trouble-free performance.

The employment of Climax valves, controls, regulators or relays have in many cases eliminated manual operations, varied, increased or multiplied the functions of equipment, supplied additional safety factors and reduced the supervisory requirements. At BS&B headquarters a large Climax engineering staff is available to assist you with your problems. Your inquiries will be treated in strict confidence.

Write today on your company letterhead for latest issue of the Climax Controls Catalog.

BS&B

BLACK, SIVALLS & BRYSON, INC.

Climax Controls Division, Dept. 60-R

7500 East 12th Street Kansas City 3, Missouri

Why Phosphorized Admiralty Condenser Tubes?

They Resist Corrosion by Most Natural Waters

Whether you use fresh, salt or brackish circulating water, service records testify that Admiralty metal tubes have given very satisfactory performance in stationary power plant condensers.

Such corrodents as carbon dioxide, hydrogen sulfide, chlorine and metal salts, in the concentrations normally found in natural waters, or used in their treatment, are effectively resisted by tubes made of Admiralty.

Adding as little as 0.02% *Phosphorus* to Admiralty gives maximum resistance to dezincification while retaining all the other desirable properties of this alloy.

In order to assure uniform chemical composition and *soundness*, Scovill produces its Phosphorized Admiralty tubes by the continuous billet-casting process which continuously maintains the optimum amount of phosphorus. The tubes are hot-extruded from the continuous-cast billets, then are cold-drawn, annealed, cleaned and finished to produce tubes of uniform temper, gauge, straightness, roundness, diameters, length and freedom from burrs.

A Condenser Tube Booklet is available to qualified users who request it on their business letterhead. Scovill Manufacturing Company, 15 Mill Street, Waterbury 20, Connecticut.

Only Scovill Phosphorized Admiralty Has All These Advantages . . .

- Uniformity and soundness resulting from Scovill continuous-casting techniques
- Relative immunity to dezincification
- Excellent performance in fresh, salt or brackish waters
- High resistance to steam and condensate
- Unquestioned heat transfer characteristics
- Superior resistance to general corrosion
- Good resistance to velocities under 7 fps.

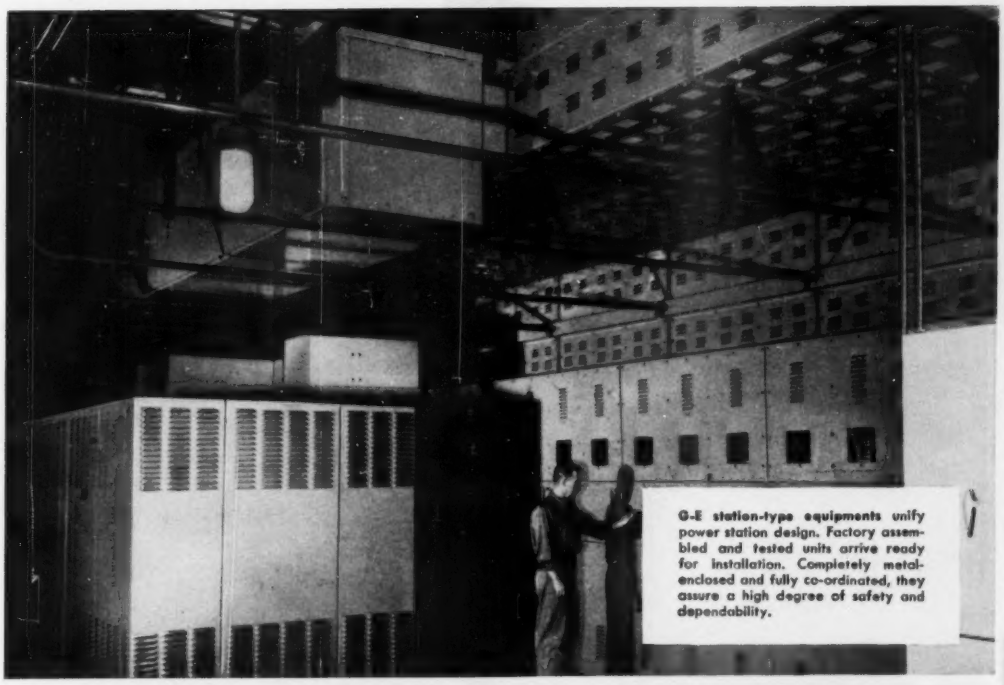
SCOVILL

A PRODUCT OF SCOVILL

B-1-5

SCOVILL CONDENSER TUBES

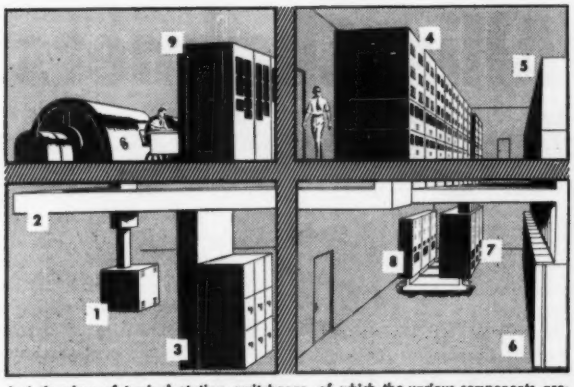
"You can't buy better brass"



G-E station-type equipments unify power station design. Factory assembled and tested units arrive ready for installation. Completely metal-enclosed and fully co-ordinated, they assure a high degree of safety and dependability.

FORMULA FOR UNIFIED POWER STATION DESIGN . . .

Complete project planning with packaged equipment



Artist's view of typical station switchgear, of which the various components are: (1) Neutral grounding breaker and resistor; (2) Generator buses; (3) Generator surge and potential transformers; (4) Generator and feeder cubicles; (5) Feeder transfer bus; (6) Feeder cable entrance units; (7) Synchronizing reactors; (8) Synchronizing bus; (9) Duplex control board.

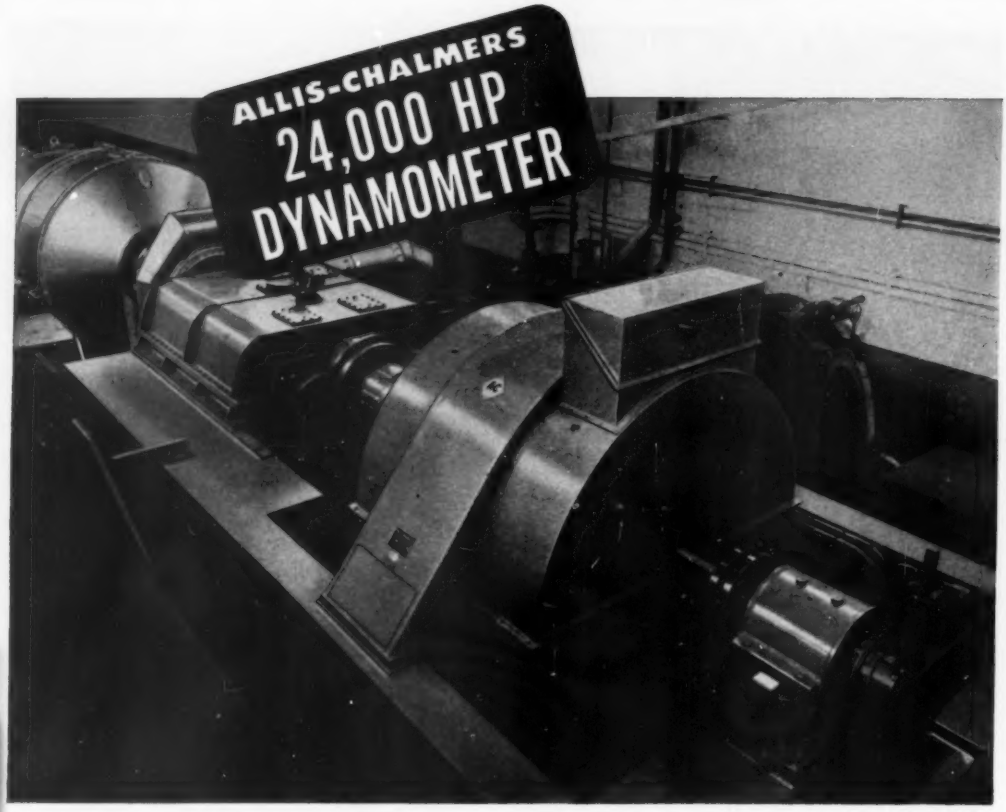
G-E station-type equipments provide the modern method for getting unified power station design. These standardized units readily combine into a compact, integrated system matched to your requirements. Factory assembled and tested, they provide a degree of over-all co-ordination difficult to achieve in any other way.

Standardized "packaged" units include circuit breakers, associated switching equipments and interconnecting buses. Each has been given the large investment in design time and high degree of design refinement warranted by repetitive manufacture. All are completely metal enclosed and fully co-ordinated to assure greater safety and dependability.

For complete information concerning the many advantages of G-E station-type equipments, see your local G-E sales representative, or write the General Electric Company, Schenectady 5, N. Y.

GENERAL ELECTRIC

855-28



Another Example of Allis-Chalmers Engineering

DESIGNING AND BUILDING this special power-delivering dynamometer required engineering skill available only to a company such as Allis-Chalmers with its century of engineering experience.

Arranged for direct measurement of torque, the dynamometer has an accuracy of ½% of the rated torque. Its overall speed range is 1210 to 15,072 rpm. And the 24,000 hp synchronous motor and its speed-increasing gear are supported by a special hydrostatically mounted base. Although the assembly weighs 130,000 pounds, it is so well balanced and cradled that it can be moved by the pressure of a man's finger.

The dynamometer was built for the Pratt & Whitney Aircraft Division of United Aircraft Corporation for testing turbo-jet engines. Allis-Chalmers also supplied the torque measuring equipment, metal-enclosed bus duct and switchgear.

Whether you need special or standard equipment—for power generation, distribution or utilization — you can benefit from this engineering experience by calling your nearby A-C representative. Allis-Chalmers, Milwaukee 1, Wis.

A-3501

ALLIS-CHALMERS

Hand-tailored to any size you need...

...Goetze Heat Exchanger Gaskets are precision-made for longer service

Whether your requirements call for heat exchanger gaskets larger than 100" in diameter, or smaller than 10", you can get the exact size you want . . . hand-tailored to the shape you need . . . simply by specifying "Johns-Manville Goetze."

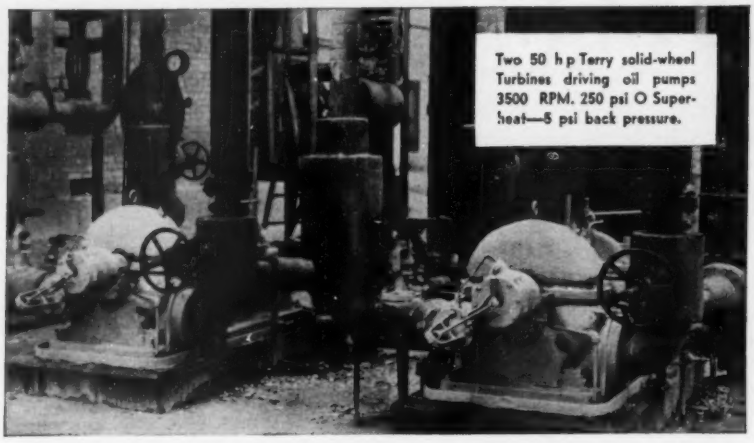
And because they're *precision-made*, you'll find these better gaskets provide the effective sealing and longer life that make them actually cost less in the long run. Each gasket is carefully constructed in every detail to assure accuracy of fit . . . to provide ample lap widths and uniform rib widths . . . and to prevent trouble-making wrinkles or cracks on the corners.

If you're having trouble with persistent joint leakage and frequent gasket replacements, find out how little it costs to have Goetze Heat Exchanger Gaskets tailored to your requirements. Your blueprint or template will bring a prompt estimate. Address Johns-Manville, Box 290, New York 16, New York.

Johns-Manville Goetze GASKETS

THERE'S A JOHNS-MANVILLE PACKING AND GASKET FOR EVERY SERVICE

TERRY



Two 50 h p Terry solid-wheel Turbines driving oil pumps 3500 RPM. 250 psi O Superheat—5 psi back pressure.

LARGE BLADE CLEARANCES GIVE ADDED DEPENDABILTY

Terry Turbine blades have the protection of generous radial and axial clearances. Axial clearance is so large—a full inch—that end play can do no damage.

Projecting rims at both sides of the wheel give further protection to the rotor buckets. Should clearance become reduced, these rims will take rubbing without damage to the blades.

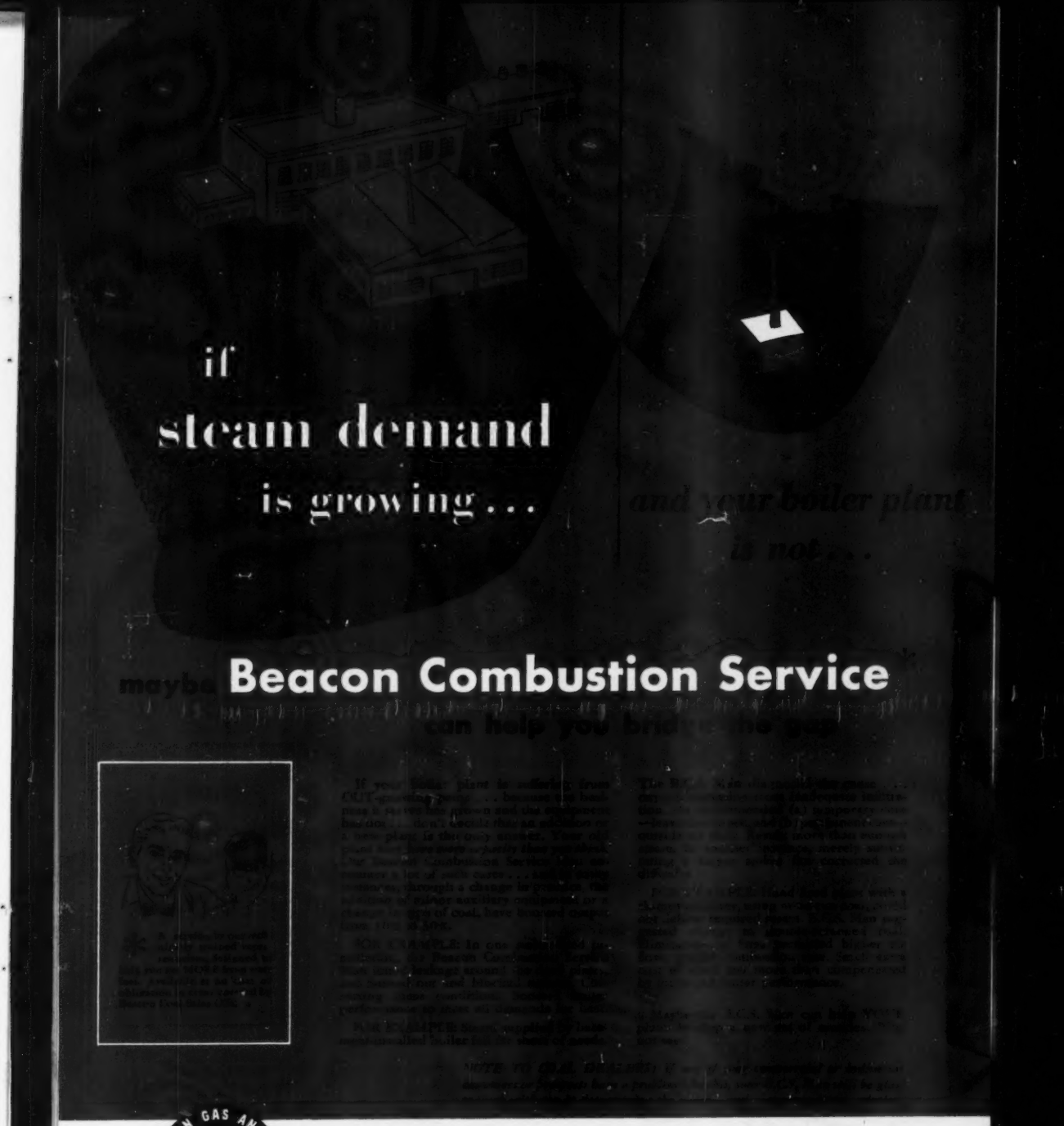
This construction also makes frequent inspection of thrust bearings unnecessary.

A request on your business letterhead will bring you Terry Bulletin S-116 giving detailed information about these features and other Terry Turbine advantages.

If you have a specific turbine drive job in mind, our district Terry representative will be glad to discuss it with you.

T-1174

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.



if
steam demand
is growing...

and your boiler plant
is not...

maybe **Beacon Combustion Service**
can help you bridge the gap

EASTERN GAS AND FUEL ASSOCIATES

EASTERN GAS AND FUEL ASSOCIATES

PITTSBURGH BOSTON CHICAGO CLEVELAND DETROIT NEW YORK
NORFOLK PHILADELPHIA SYRACUSE

For New England: New England Coal & Coke Co., *For Export:* Castner, Curran & Bullitt, Inc.

Today you need a packing that lasts longer

HERE IT IS

Now, when you must meet tight production schedules, you'll need GARLOCK *Lattice-Braid* to help you avoid frequent shut-downs for re-packing—for *Lattice-Braid* is designed for long, continuous service.

All the strands of *Lattice-Braid* packing are lattice-linked together into a structural unit which holds together, even when the packing is worn far beyond the limits of wear of ordinary braided packings.

GARLOCK *Lattice-Braid* is supplied in several styles listed at the right. Write for folder today.

THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK

In Canada: The Garlock Packing Company of Canada Ltd., Toronto, Ont.

GARLOCK *Lattice-Braid* PACKING

ASBESTOS

GARLOCK 730-for hot or cold water at medium to high pressures.

GARLOCK 731-for steam, gases or water at temperatures up to 700°F.

GARLOCK 732 (wire inserted)-for heavy duty service against steam, oil, gases or water at temperatures up to 700°F.

GARLOCK 733-for hot or cold water or alcohol at medium or low pressures.

GARLOCK 734-for cold gasoline, kerosene and light oils.

GARLOCK 736 (blue asbestos)-for concentrated mineral acids.

FLAX

GARLOCK 740-for cold water at medium or low pressures.

GARLOCK 745-for heavy hydraulic service against cold water.

COTTON

GARLOCK 751-for hot or cold water.

TEFLON

GARLOCK 5733-for all acids, all alkali solutions and all organic solvents.

standard HAGAN

RING BALANCE METERS

give reliable readings

over the *full chart range*

The simple, radial torque principle used in Hagan Ring Balance Meters gives dependable results over the entire chart range. For example, the operator who brings a boiler onto the line can depend on the Hagan Boiler Meter to indicate the instant the boiler starts delivering steam.

Hagan Ring Balance Meters readily handle high differentials—up to 420″ of water column—which are a source of difficulty in conventional meters.

Other important features of the Hagan Ring Balance Meter include:

- ★ **No stuffing boxes**
- ★ **Ease of dead weight calibration**
- ★ **High sensitivity at low flow rates**
- ★ **Adjustable full scale range**
- ★ **Easy and inexpensive maintenance**

Clip the coupon for additional information about how Hagan Ring Balance Meters can serve you.

HAGAN CORPORATION

RING BALANCE FLOW AND PRESSURE INSTRUMENTS
THRUSTORQ FORCE MEASURING DEVICES
BOILER COMBUSTION CONTROL SYSTEMS
METALLURGICAL FURNACE CONTROL SYSTEMS

• HAGAN RING BALANCE METERS • HAGAN

HAGAN RING BALANCE METERS

Hagan Corporation
Hagan Building
Pittsburgh 30, Pennsylvania

Please send me further information on Hagan Ring Balance Meters. I am particularly interested in .....

NAME .....

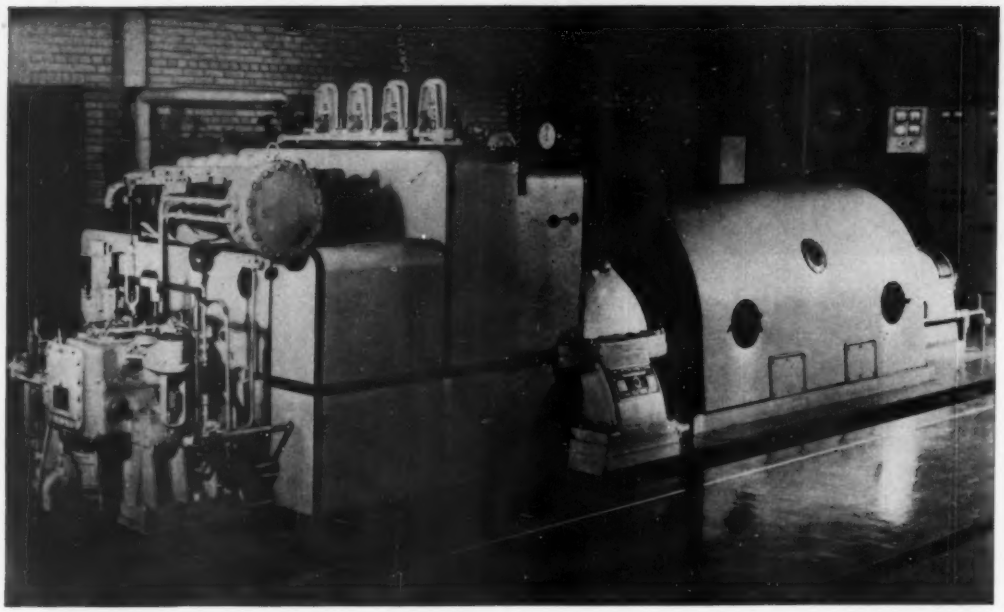
POSITION .....

COMPANY .....

STREET AND NUMBER .....

CITY ..... ZONE ..... STATE .....

PE-11



Story of an Economy Drive

How the Worthington Steam Turbine Pays Dividends for the City of Litchfield

What happened at Litchfield, Minnesota, is a clue to a most economical power plant operation.

Originally, the Litchfield municipal power plant consisted of low-pressure boilers, a steam engine and a small turbine-generator unit. The exhaust steam is sold for municipal heating.

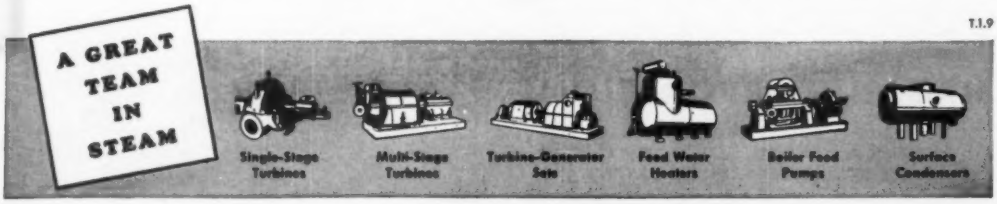
Next—a Diesel engine-driven generator was installed. The load grew, and finally, after a careful survey, it was decided to install a 3000-kw Worthington turbine generator and automatically extract steam for heating purposes.

Worthington builds steam turbines in all types and sizes—and turbine-generator sets up to 10,000-kw. For proof *there's more worth in Worthington*, call our nearest office or write to Worthington Pump and Machinery Corporation, Steam Turbine Division, Wellsville, New York.

WORTHINGTON

STEAM TURBINE GENERATORS

T.1.9



from Arizona to Arabia

it's a* DriCooler *world . . .

Climates vary . . . cooling requirements differ—but preference for Marley DriCoolers is world-wide, as evidenced by the exceptional interest shown in the ever-increasing number of DriCooler installations throughout the world. Consider all factors — weather conditions, fluid to be cooled, horsepower required, influence of corrosion, and many more — and you'll find that Marley offers you the best, most economical dry cooler for your specific job.

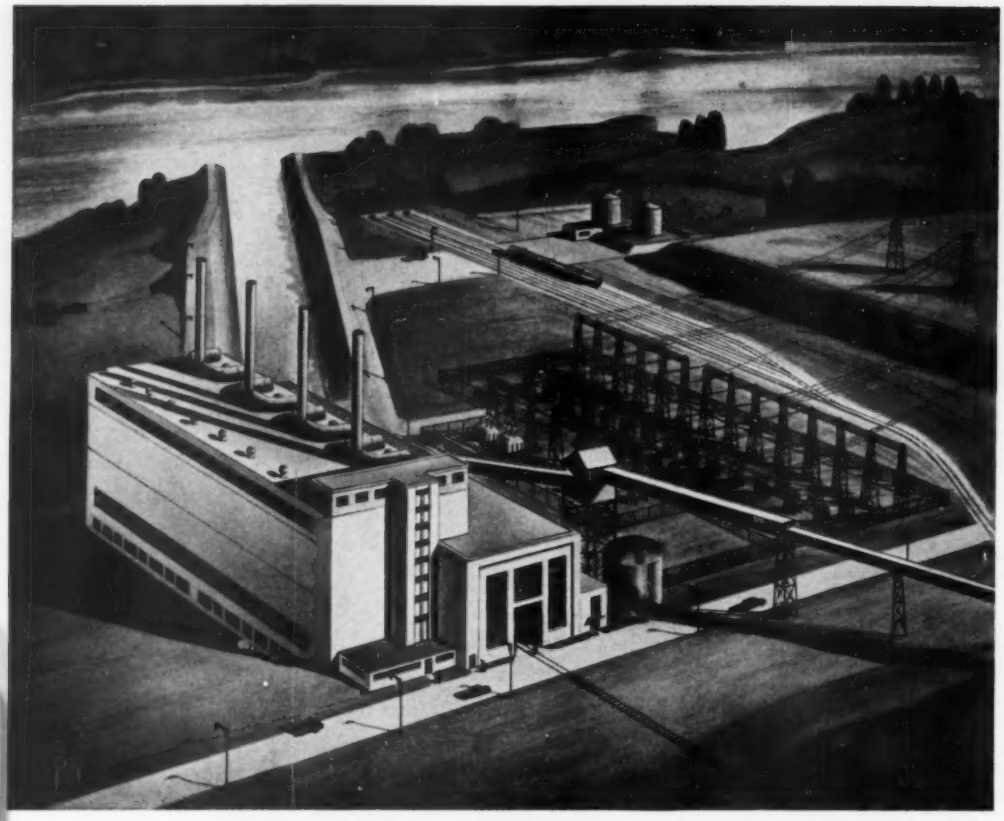
This is so because Marley makes a *complete* line of DriCoolers in a wide range of capacities and designs; because each Marley DriCooler is *engineered for the job*, whether it be to cool jacket water in the Arctic or lube oils in the burning desert.

There's a Marley application engineer in every major city, whose services and experience are yours for the asking. Call your Marley man for full details or write for Bulletin DC-50.

Also producers of
AQUATOWERS
VAIRFLO TOWERS
DOUBLE-FLOW TOWERS
NATURAL DRAFT TOWERS
SPRAY NOZZLES

MARLEY

The Marley Company, Inc.
KANSAS CITY 15, KANSAS



POWER FOR MORE THAN A MILLION HOMES

The power produced in this great 200,000 KW steam generating power plant is enough to supply several million people with light and power.

To India where this has taken place, The Kuljian Corporation has sent men, materials, equipment and supplies to construct and operate this power station which was previously engineered and designed at our headquarters in Philadelphia.

Kuljian engineering and construction skill and resources have been applied to a wide range of utility and industrial projects under varying conditions in many parts of the world.

This seasoned experience in Engineering and Construction is also available to you.

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CALCUTTA, INDIA
ROME, ITALY
CARACAS, VENEZUELA
MEXICO CITY, MEXICO

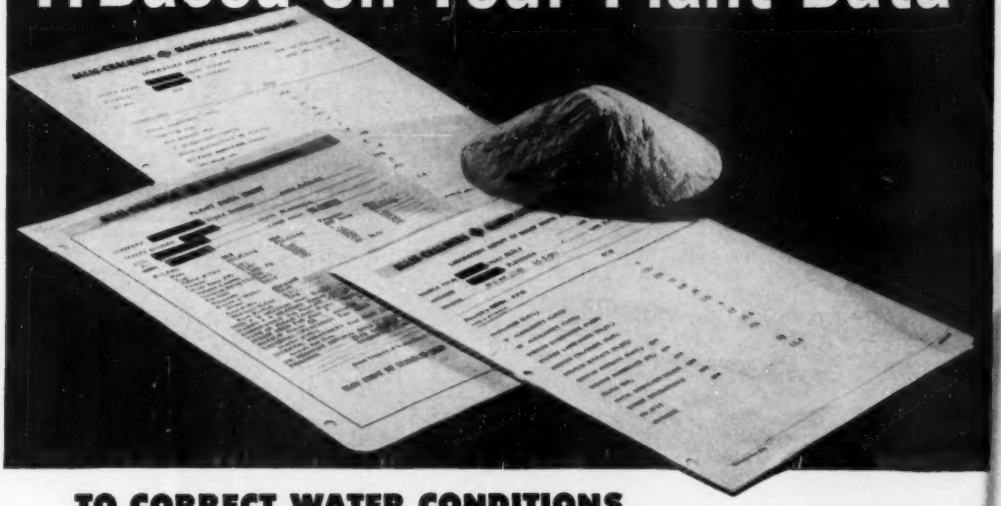
The **Kuljian** *Corporation*

ENGINEERS • CONSTRUCTORS

1200 NORTH BROAD STREET, PHILADELPHIA 21, PA.

℞ ALLIS-CHALMERS No. 30 SERIES Boiler Feedwater Treatment

..Based on Your Plant Data



TO CORRECT WATER CONDITIONS USE THE CORRECT TREATMENT

THE RIGHT PROTECTION in the right amount is given by Allis-Chalmers No. 30 Series powder formulations — protection against scale, corrosion and embrittlement (if required). The materials used, their proportions and the rate of feeding are prescribed by Allis-Chalmers specialists, and each formulation is based on the characteristics of the plant it is to serve.

There are no secrets connected with No. 30 Series treatments. These formulations are the logical chemicals in the proper proportions to control undesirable elements revealed by a study of your plant data. No stock "boiler compound" can equal this straightforward, effective internal treatment for boilers in the low and medium pressure ranges.

A trial period for a No. 30 Series treatment can be arranged for your plant if our studies indicate that it will prove helpful.

FOR A COMPLETE, BRIEF discussion of the Allis-Chalmers No. 30 Series internal treatments, send for bulletin number 28X7531. If you wish, your nearby Allis-Chalmers office can arrange to have your water problem brought before our specialists for study.

Allis-Chalmers
Milwaukee 1, Wisconsin

Gentlemen:
Please send me bulletin 28X7531.

Name

Title

Company

Address

City State

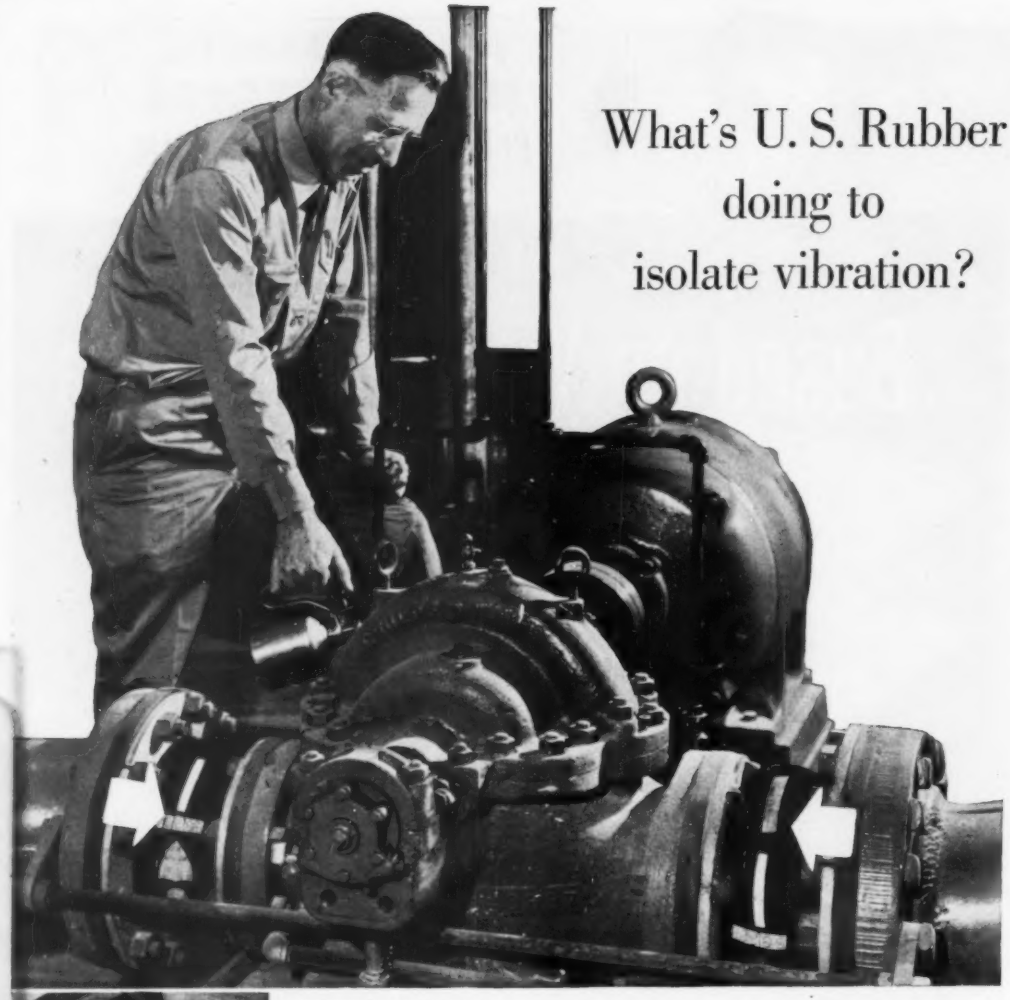
A-5376

ALLIS-CHALMERS

Water Conditioning

✓EQUIPMENT ✓CHEMICALS ✓SERVICE

What's U. S. Rubber doing to isolate vibration?



ENGINEER OILING the 40 H. P. pump which forces 2500 gallons of cooled water per minute to the top of the 21-story building. The expansion joints are indicated by arrows.

SHOWING EXPANSION JOINT in return line from cooling tower and leading to the storage tank.

A TYPICAL example is found in a 21-story Middle Western skyscraper. A large pump in the air conditioning system is equipped with U. S. Wire-Wound Expansion Joints, to isolate vibration, and take up misalignment and provide for axial and transverse movement.

U. S. Expansion Joints are flexible connections used in pipe lines, in mechanical equipment used for the generation of electricity and for pressure or vacuum lines in general. Since they have no moving parts to wear or bind, they give many, many years of trouble-free service. They can be made resistant to fire, oil, gases, acids and other chemicals.

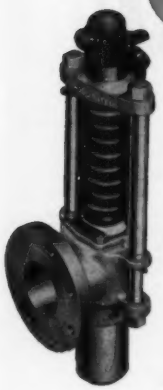
Bring your vibration problems to U. S. Rubber's engineers for solution. Write to address below.

PRODUCT OF U.S.RUBBER SERVING THROUGH SCIENCE

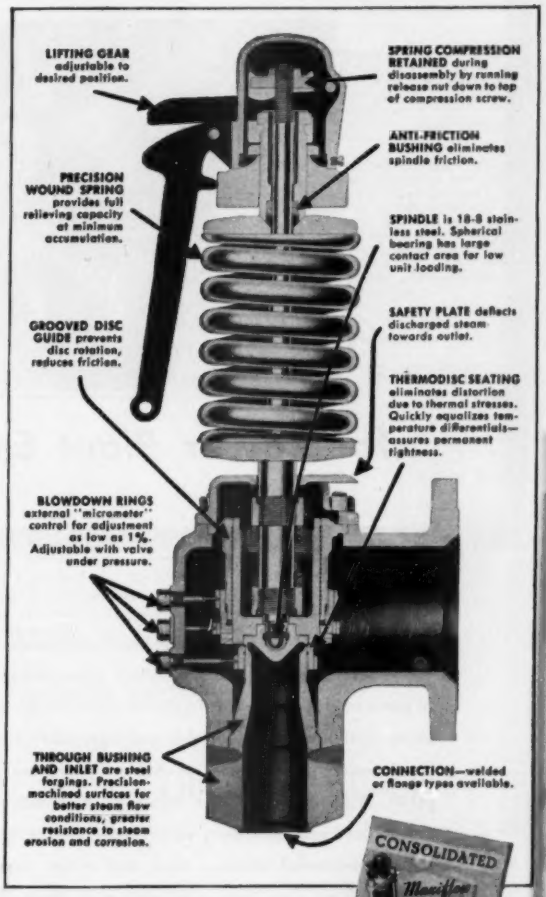
UNITED STATES RUBBER COMPANY

MECHANICAL GOODS DIVISION • ROCKEFELLER CENTER, NEW YORK 20, N. Y.

FOR *Greater* DISCHARGE CAPACITY...



CONSOLIDATED *Maxiflow* SAFETY VALVE


LIFTING GEAR adjustable to desired position.
SPRING COMPRESSION RETAINED during disassembly by running release nut down to top of compression screw.
ANTI-FRICTION BUSHING eliminates spindle friction.
PRECISION WOUND SPRING provides full relieving capacity at minimum accumulation.
SPINDLE is 18-8 stainless steel. Spherical bearing has large contact area for low unit loading.
SAFETY PLATE deflects discharged steam towards outlet.
GROOVED DISC GUIDE prevents disc rotation, reduces friction.
THERMODISC SEATING eliminates distortion due to thermal stresses. Quickly equalizes temperature differentials—assures permanent tightness.
BLOWDOWN RINGS external "micrometer" control for adjustment as low as 1%. Adjustable with valve under pressure.
THROUGH BUSHING AND INLET are steel forgings. Precision-machined surfaces for better steam flow conditions, greater resistance to steam erosion and corrosion.
CONNECTION—welded or flange types available.

High-pressure, high-temperature steam generating equipment demands safety valves with greater discharge capacity. Consolidated Safety Valves first saw service in 1879. Today, every feature modern engineering can contribute is incorporated in Consolidated *Maxiflow* Safety Valves to provide the greater discharge capacity so essential in steam generating plant operations.

EXAMPLE: 2½" MAXIFLOW

Gauge Pressure P.S.I.	Capacity Saturated Steam Pounds Per Hour A.S.M.E. Rating
1200	143,700
1500	179,000
2000	238,400
2500	297,600

Whatever size safety valve you need in your plant—1½", 2", 2½", 3" or 4"—you can rely on Consolidated Maxiflow to discharge maximum flow, with shorter blowdown. Popping point retention is achieved by combining proper compensation with materials having low coefficients of expansion. These and many other performance features set a new standard in safety and service.

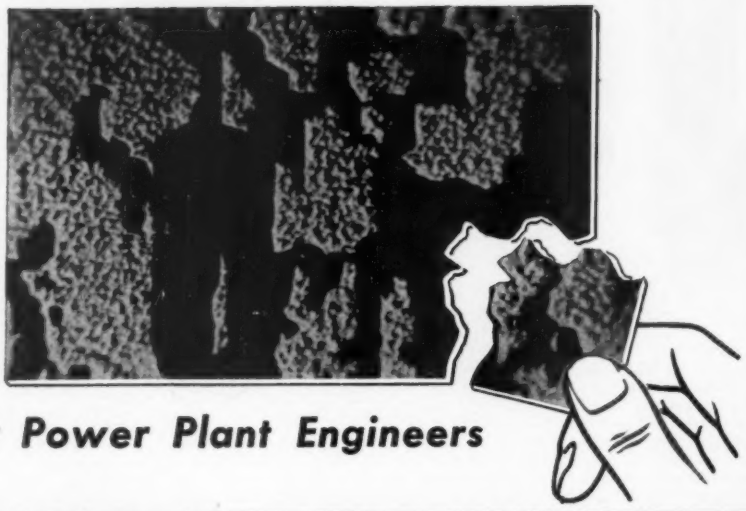
For complete data, including capacity tables, write for Bulletin 707.

CONSOLIDATED SAFETY VALVES

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONNECTICUT

MAKERS OF 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'HANCOCK' VALVES, 'ASHCROFT' GAUGES. BUILDERS OF "SHAW-BOX" CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.

JIG-SAW PUZZLE



for Power Plant Engineers

MAGNESIUM scale, magnified fifty times, can look like the jig-saw puzzle it often represents to plant engineers when it begins to affect boiler operation. Quick solution for this and any other scaling or corrosion problem is The Nalco System for your plant. High quality water treating chemicals, plus expert field and laboratory surveillance assure continuously successful results — now, and in the years to come, as long time Nalco customers will affirm. Write for your no-cost Nalco Water Treatment Survey today.

NEW DATA ON SCALE IN HIGH PRESSURE BOILERS

Reprints of "Experimental Studies of Boiler Scale at 2,500 p.s.i.," a paper presented at the 1950 Water Conference of the Engineer's Society of Western Pennsylvania, are available free upon request to Nalco. Article includes numerous photos of scale formations on test boiler tubes, and charts showing results of various water treatment methods.

NATIONAL ALUMINATE CORPORATION
6224 W. 66th Place • Chicago 38, Illinois
Canadian inquiries should be addressed to
Alchem Limited, Burlington, Ontario

THE *Nalco* SYSTEM . . . Serving Industry through Practical Applied Science

HELPFUL BULLETINS

Answers to many operating and maintenance problems will be found in these new bulletins and catalogs. List paragraph numbers of those you want on coupon below, detach and mail

VALVES, PIPING AND ACCESSORIES

101 Boiler Blow-Off Valves — Bulletin B-425, 24 pp, is a new edition of company's booklet on blow-off valves and provides up-to-date information on valves for pressures to 400 lb. Describes and illustrates two types of seatless valves, also double-tightening valves, giving construction features, specifications, dimensions and prices, and picturing typical installations. Yarnall-Waring Co.

102 Valve Reference Guide — A handy, quick reference guide to manufacturer's cast and forged steel valves primarily for power plant installations, including industrial is designed for easy identification of valves applicable to power plant use. These valves are illustrated and described in detail; other valves are listed, but described briefly. Pictorial content covers company's Univalves, blow-off, instrument, non-return, cast steel check, and cast and forged steel globe and angle valves. Edward Valves, Inc.

103 Manifold Discharge Piping Application — Manual 51-B, 34 pp proposes an approach to design of discharge header systems based on partial or complete elimination of back-pressure effects on tied-in safety-relief valves. Claimed to offer great savings on cost of conventional discharge piping, manual gives operating test data on company's line of FarriSeal and BalanSeal bellows-type safety relief valves. Analyzes economics of standard design practice as it affects cost of pressure relief in closed systems where control or recovery of lading fluid is essential. Farris Engineering Corp.

104 Pipe and Fitting Materials — Presenting at-a-glance information including ASTM specifications, chemistry, service temperature limits and welding characteristics, this 3-color chart covers a wide range of pipe and fitting materials according to name or standard type numbers. Includes carbon steels and wrought iron, stainless and intermediate alloy steels, nickel, aluminum and copper and alloys of these metals. Tube Turns, Inc.

105 Industrial Expansion Joints — Forty-pp Catalog 51 contains over 78,000 possible combinations of bellows type expansion joints and serves as a reference handbook, illustrating standard and special assemblies used to take up expansion, contraction and offset movements in pipes and conduits. Several unique designs are described, as well as unusual bellows applications for absorbing motions resulting from pressure or temperature changes in conducted gases and liquids. These assemblies range from ½ to 72 in. pipe sizes, cover pressures from vacuum to 1000 lb, and are made from stainless steel and a variety of heat- and corrosion-resisting alloys. Solar Aircraft Co.

106 Nickel Pipe and Tubes — Bulletin T-17 is a 27-pp technical bulletin on the fabrication and design of nickel and high nickel alloy pipe and tubing, illustrated throughout by drawings and photos. Presents tables on mechanical and physical properties, ASME code requirements, recommended welding procedures and other information. The International Nickel Co., Inc.

107 Plus Protection — Vol. 2, No. 2 of the Magnesium Anode is a 2-pp discussion of the value of supplemental cathodic protection for coated pipelines, using magnesium anodes as a source of current. Dowell, Inc.

ELECTRICAL

108 Vertical Induction Motors — Data on ratings, construction and types of large vertical induction motors are contained in Bulletin 05B7629. Widely used for pumps and other vertical drives, vertical solid shaft induction motors described are available in ratings upwards from 60 hp at 200 rpm. Except for bearing arrangement, mechanical construction of the motors is similar to that of horisontal units. Allis-Chalmers Mfg. Co.

109 Battery Rack Specifications — Data-sheets 72056, 72057 and 72074 give design specifications for single- double- and triple-tier racks for installing 12-, 24-, 30- and 60-cell batteries. Each sheet comprises keyed line drawings of rack type to which the particular sheet pertains and includes tables giving dimensions of racks to be used with different cell sizes. Length, width, height and number of rack sections required for four different types of batteries are included. Gould-National Batteries, Inc.

110 Mercury Switches — Four-pp Condensed Catalog Hg-1 covers five most popular designs of company's mercury switches, with selection and application aids, and complete electrical ratings and data for the use of these switches in both a-c and d-c applications. Micro Switch.

111 Motor Starters for Hazardous Spots — This 8-pp folder illustrates and describes company's Explo-Safe and Weatherproof motor controls for hazardous locations. Gives dimensions, weights, ratings and wiring diagrams for these magnetic across-the-line starters.

112 Standard Cable Trough — Stressing economy, versatility and other advantages of company's standard steel mesh trough for support of control cable and instrument tubing. 6-pp Bulletin 64-A illustrates trough sections, cover, connectors and other fittings. A variety of installation photos show how these standard items solve problems involving turns, odd angles, changes in elevation, etc. T. J. Cope, Inc.

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INSTRUMENTS AND CONTROLS

113 To Get Full Measure — Information on how to select electrical measuring instruments is provided in 30-pp Booklet B-4096. Seven basic factors are explained; types of instruments available in each major classification are listed on a full-page check chart; and four typical selection problems are solved. Complete lines of portable, switchboard, panel, recording and socket instruments are described and illustrated and functions of each are explained. Westinghouse Electric Corp.

114 Electronic Control System — Bulletin A-701 introduces company's Autronic system, a miniature all-electronic system for controlling pressure, temperature, flow and level, intended for use in chemical processing plants, refineries, central stations, other applications where fast, accurate control is required. Illustrated with photos, dimensional drawings and a schematic diagram showing operating principle, describes control unit, recorder unit, optional manual control unit. The Swartwout Co.

115 Instruments, Control Systems — Twelve-pp Catalog 513 presents manufacturer's line of instruments, control systems, regulating valves and desuperheaters. Covers draft and pressure instruments, boiler meters, recorders, thermometers, regulators, combustion controls, pump controls and many others. Illustrates each instrument, describes it briefly as to design and application and lists specific literature available on it. Republic Flow Meters Co.

116 Combustion Control at Brewery — An 8-pp case history of modernization and expansion in the boiler room of a St. Louis brewery is given in Bulletin R-6. New equipment added, building changes, uses for steam and boiler conditions are described, pictured. Text, photos and schematic drawings trace the operation of the combustion control system, and results obtained with the new equipment are listed. The Hays Corp.

117 Temperature Regulators — Twelve-pp Bulletin T, Catalog 80, describes manufacturer's line of regulators for controlling temperature of liquids and gases, giving their applications, operating characteristics, construction specifications, dimensions. Eight instruments are presented covering temperature regulation for a wide range of heating and processing requirements. Fully illustrated, includes selection and application chart. Foster Engineering Co.

118 Flow Signal Transmitter — Technical information on a high pressure type of flow signal transmitter is presented in 8-pp Bulletin 2551. Design and operation of the transmitter is explained and illustrated in color; seven applications are discussed, and various types of differential elements described. Covers operating characteristics, range adjustability, calibration of the instrument, includes dimensions. Hagan Corp.

119 Automatic Compensator — Automatic compensation for temperature and/or pressure by company's automatic compensator is described in Catalog 975, 4 pp. Tells how this simple mechanical system provides accurate flow measurement, how compensator operates, offers wide range. Diagrams on installation and discusses applications. Penn Industrial Instrument Corp.

120 Gas Regulator — Eight-pp Bulletin P-298 introduces a gas regulator for pressure reduction service where regulation must be maintained with high sensitivity and accuracy, as on gas distribution systems, heat treating, boiler plants. Several models are presented. Sectional views show regulator's simplicity of design; principle of operation is explained, illustrated in color. Includes construction details on body and pilot assemblies, dimensional data, recommended operating limits. Fisher Governor Co.

121 Pressure Transmitters — Engineering Data Folders 61, 69, 70 and 71 illustrate and describe a complete line of pressure measurement transmitters including a Bourdon tube pressure transmitter, a gage pressure bellows transmitter, an absolute pressure transmitter and a differential pressure cell, all featuring differential transformer type transducers and designed for use with standard recorders and indicating instruments having dead-beat response servo receivers. Includes application data, operational features, available ranges, wiring and case diagrams. Automatic Temperature Control Co., Inc.

122 How Good Is that Furnace? — Form 926 describes and illustrates the Heat Prover, an instrument for measuring the combustion efficiency of any type furnace using any type fuel, giving both instantaneous and continuous readings. Tells how instrument works, explains advantages in checking performance of boilers, open hearth furnaces, kilns, heat treating furnaces, crucibles. Cities Service Oil Co.

123 Recording Oscillograph — CEC Bulletin 1500B describes a multichannel, precision instrument for analysis and measurement of strain, vibration, pressure, acceleration and other phenomena. Discusses evaluation by dynamic testing, explains this oscillograph in detail, illustrating its optical system and listing standard equipment. Also describes galvanometers, accessories. Consolidated Engineering Corp.

124 Electronic Tubes — Here's a 28-pp catalog furnishing complete technical specifications and other information on tubes for control, processing, production, research, testing, counting, sorting, weighing, measuring, detecting and many other applications. Features nationally-known brands. Milo Radio and Electronics Corp.

MECHANICAL POWER TRANSMISSION

125 Stock Chains and Sprockets — Thirty-pp Catalog C 55-50 gives details on list prices, available sizes of three types of stock sprockets and pertinent information on stock roller chain from ¾ to 2 in. pitch. Includes data on drive selection, service factors, as well as illustrated installation tips and maintenance procedures. Explains economy and convenience of using stock products. Morse Chain Co.

126 Speed Reducer Manual — Pocket-size Catalog 51 covering manufacturer's speed reducers and right angle gear motors gives 96 pp of engineering data on how to select proper speed reducer to fit requirements, including horsepower ratings, ratios and installation graphs. Includes parts list, descriptive material on gear types and sizes, also photos and listings of flexible couplings. Abart Gear & Machine Co.

127 Helpful Data on Chain Drives — Compiled as a data book, 32-pp Catalog HD-51 offers a simple, quick means of determining interchangeability of various

(Continued on page 120)

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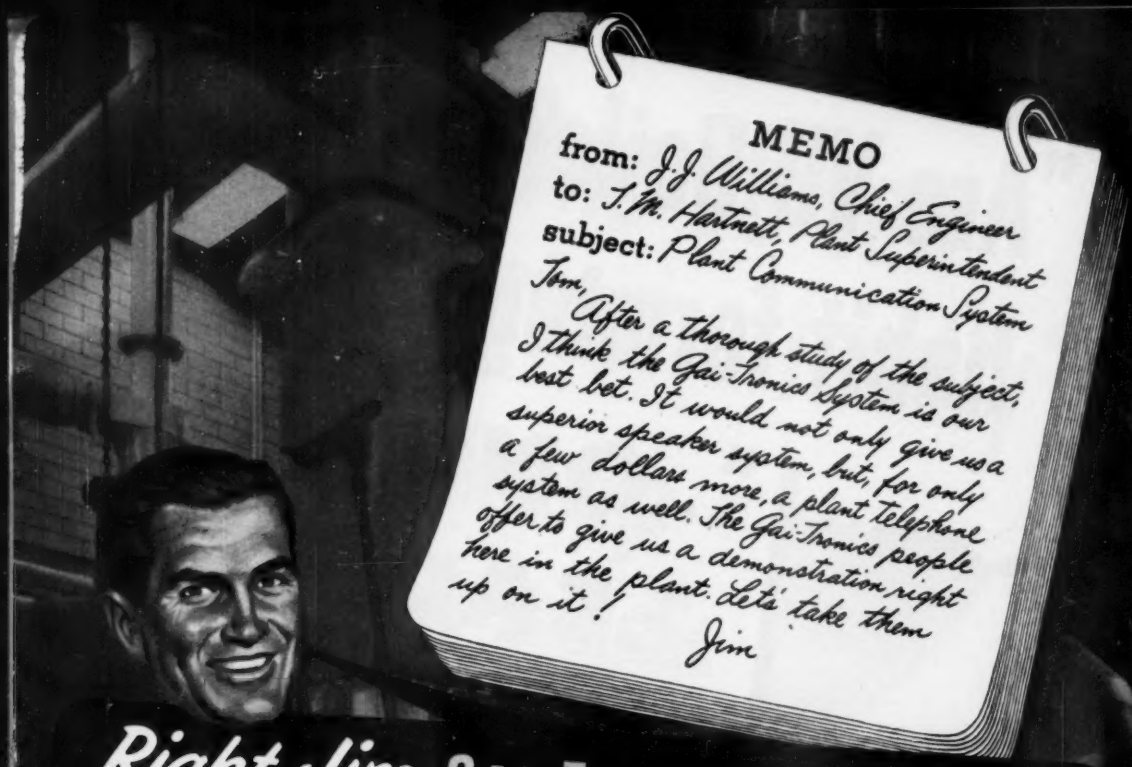

MEMO
from: J. J. Williams, Chief Engineer
to: T. M. Hartnett, Plant Superintendent
subject: Plant Communication System
Tom,
After a thorough study of the subject, I think the Gai-Tronics System is our best bet. It would not only give us a superior speaker system, but, for only a few dollars more, a plant telephone system as well. The Gai-Tronics people offer to give us a demonstration right here in the plant. Let's take them up on it!
Jim

Right, Jim, GAI-TRONICS GIVES YOU TWO COMMUNICATION SYSTEMS IN ONE

Only by choosing a GAI-TRONICS Power Plant Communication System, can you get a *complete* system—far more versatile than an ordinary public address hookup with an unhandy, separate intercom.

GAI-TRONICS Systems are *custom-engineered* by Power Plant Design Engineers—men who know the problems and needs of top-notch power plant communication. GAI-TRONICS speakers and telephone handsets are specially designed for power plant operation. Even under the highest and most unusual noise levels, hearing and speaking are easy, completely unstrained.

With but a flick of a switch it is possible to change from speaker use to personal two-party or group telephone conversation. No need for two individual systems—each with its own wiring, devices, maintenance, *and expense!*

To everyday power plant operation, GAI-TRONICS brings a new standard of efficiency. During an emergency, *fast, sure* GAI-TRONICS communication can avert disaster—can more than pay for itself in a few minutes.

FREE

We want you to know more about GAI-TRONICS. At your request, we will send you an informative booklet . . . *Power Plant Communication Systems.* OR, we will be glad to give you an eye-opening demonstration with a portable GAI-TRONICS System *in your plant!* Write today!

GAI
FOUNDED 1926

"Are VU Boilers habit forming?"

"...ONE VU LEADS TO ANOTHER"

Have You seen these Headlines before?

For months past we have submitted evidence under these ad headlines on one *important point* — those who have bought C-E Vertical Unit Boilers *continue to buy them.* Here are typical cases . . . in industry after industry:

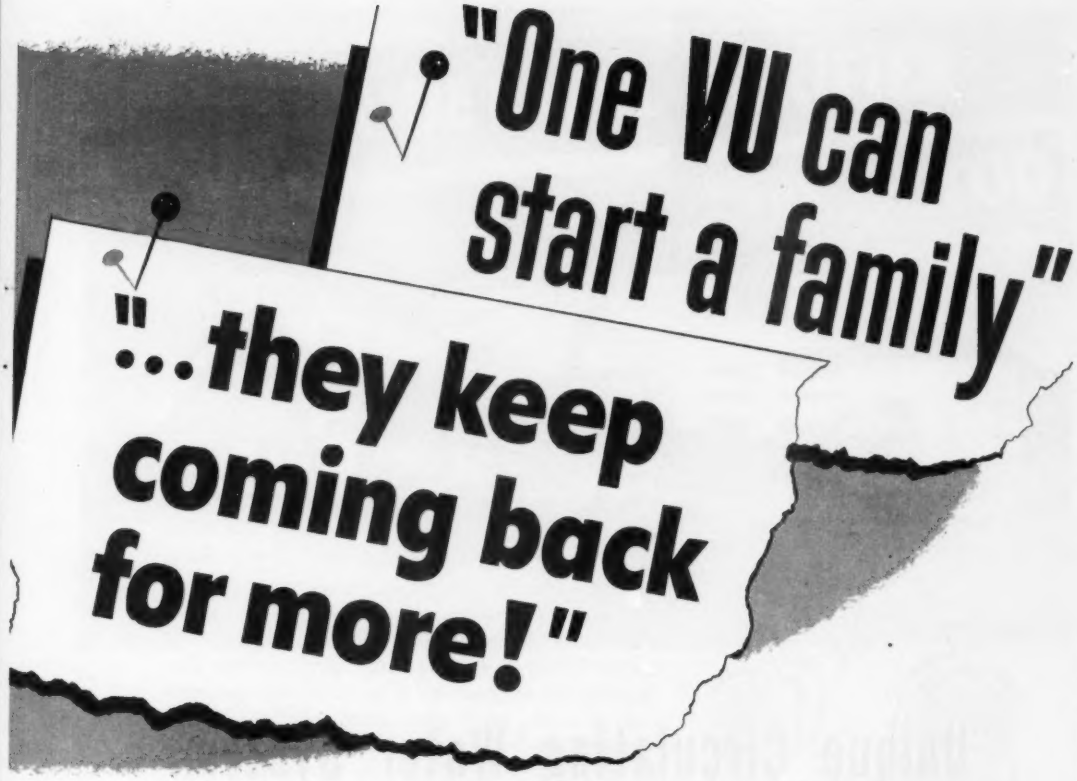
An Electric Utility Company ordered its first VU in 1941. In 1945 it ordered a second VU for a different plant. For another of its plants one unit was installed in 1946 and two more in 1947. In 1949 a VU was installed in a fourth plant, and in 1950 one was installed in a fifth plant. A total of seven boilers in five different plants.

An Oil Company ordered its first VU Unit in 1937. In 1941 another was installed and still another in 1950. For another of its plants two units were ordered in 1942 and a third in 1947.

A Paper Company installed its first VU Unit in 1947. Two more VU Units were ordered in 1948 for two of its other plants. In 1950 still another was installed in one of the same plants.

COMBUSTION ENGINEERING

ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS



A Steel Company now has a total of fourteen VU Boilers in four different plants. Starting with an installation of two units in the early thirties, it has reordered six times. The most recent installation of two units at one of its plants was completed in 1948.

A Textile Manufacturer ordered two VU Units in 1936. Another unit was installed in 1940 and a third in 1944. Still another textile company installed one unit in 1945, a second in 1949 and has just ordered another VU Unit.

An Automobile Company installed its first VU Units (2) in 1947. Two more were ordered for another of its plants in 1948; then three more units for a third plant in 1949 and two more for still another of its plants in 1950.

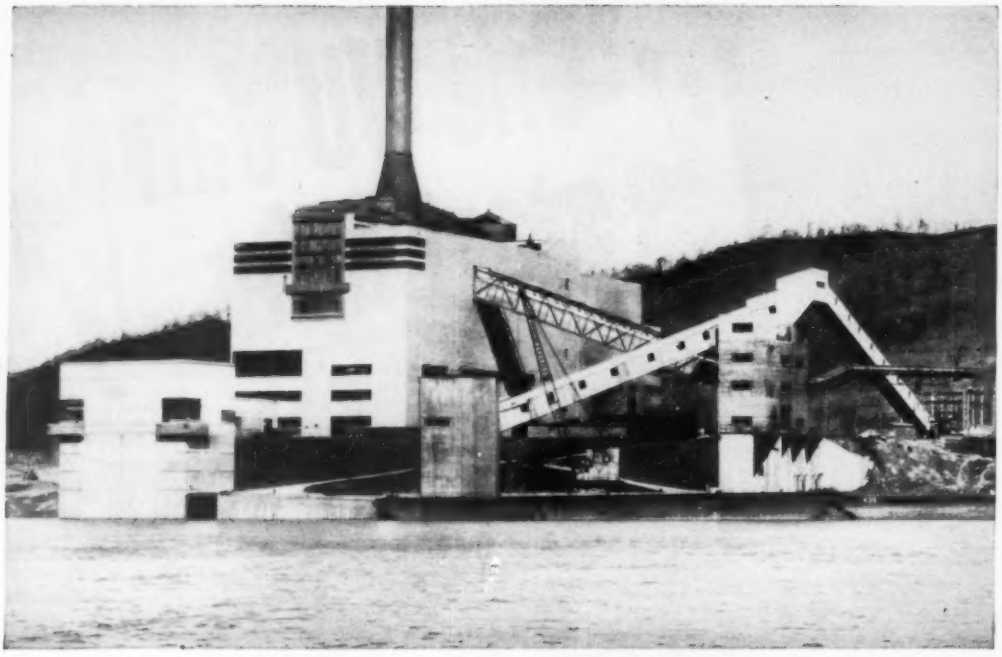
A Sugar Company ordered two VU Boilers for one of its plants before the war. In 1946 it ordered a VU for a second plant. And in 1950 another VU was installed in this same plant.

An Aluminum Company is another consistent buyer of VU Units. Since installing its first VU in 1940, it has reordered four times, and now has five C-E Vertical-Unit Boilers in service.

A Chemical Company ordered two VU Boilers in 1939. In 1946 five more were ordered for three of their other plants. In 1949 two more were ordered for one of these same plants, and in 1950 two more units for a fifth plant. In 1951 three more units were ordered for still another plant — thirteen units for six plants in twelve years! B-532

— SUPERHEATER, INC.
200 MADISON AVENUE, NEW YORK 16, N. Y.

C-E



Unique Circulating Water System Installed in This Power Plant

The R. E. Burger steam-electric plant of Ohio Edison Company is located on the Ohio River well above flood stage—which may reach as much as 60 feet above extreme low water. Water is supplied to the condensers by a patented circulating water system pioneered jointly by Worthington and the consulting engineer, Mr. George W. Saathoff.

All major equipment except circulating pumps, which are designed to operate completely submerged if necessary, are located above flood stage.

The new installation of a Worthington 70,000 sq ft two-pass condenser and auxiliaries, serving a 90,000 kw turbine-generator, is the third Worthington unit in this station. Two 46,000 sq ft condensers were previously installed.

For advice on any new installation or information on a wide range of power plant equipment, consult Worthington Pump and Machinery Corporation, Steam Power Division, Harrison, New Jersey.

HOW IT WORKS

Two full-capacity circulating pumps are used in series.* The primary pump, submerged below extreme low water, is a Worthington motor-driven HIFLO. Its high starting head characteristic is able to deliver enough water for starting purposes. A booster pump—a single-suction volute Worthington MIXFLO, mounted directly upon an hydraulic turbine—starts when there is enough water in the control well. The two pumps then operate automatically in series at full capacity.

Advantage is taken of maximum siphon effect from the condenser drop leg which enters the sealing or control well. From this well, all circulating water is passed through the hydraulic turbine. Thus the static head from sealing well to river level is utilized—75-80% being recovered—in reducing the work of the primary pump, with saving in overall pumping power.

The booster pump functions until rising water renders the turbine ineffective. Then the primary HIFLO works alone, producing full capacity under reduced head.

*In the new unit, there are two half-capacity primary pumps, permitting operation of only one in the winter when low water temperatures prevail.

Z.1.1

WORTHINGTON

WORLD'S BROADEST LINE OF STEAM POWER PLANT AUXILIARIES

Feed Water Heaters	Boiler Feed Pumps	Steam Turbines
Steam-Jet Ejectors	Water Treating Equipment	Surface Condensers

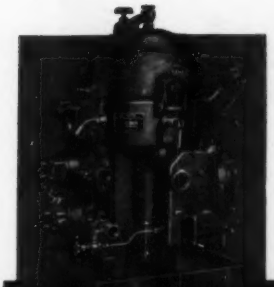
YOUR DE LAVAL PURIFIER GIVES [redacted] ,TOO

De Laval protection to turbine lubricating systems is ***double*** because it removes ***both*** of the impurities that contaminate turbine lubricating oil. Centrifugal force is the purifying agent, throwing dirt out of the oil and storing it out of the zone of purification in the bowl, simultaneously separating out any water present and discharging it continuously.

De Laval centrifugals have another advantage—they never remove oil-soluble additives. Of course, additives that are soluble in water will eventually be lost with the removed water, whether the removal is effected by centrifugal force or filters. Since very little water is usually present in the average turbine lubrication system, the amount of inhibitor that is lost is inconsequential. However, the De Laval Oil Purifier has the necessary capacity to take care of a major water leak in the system—an added protection that only a centrifuge can provide.

Write for Bulletin TU 1-8.

THE DE LAVAL SEPARATOR COMPANY
Poughkeepsie, New York 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5
THE DE LAVAL COMPANY, Limited, Peterborough, Ont.



DE LAVAL

NEW EQUIPMENT NEWS

WHAT'S NEW? On these pages the Editors summarize the outstanding industrial developments of leading manufacturers who will supply you, free of charge, the bulletins or other information desired. For ease in making requests use the non-obligation, postage-paid card pages 37–38.

1—PURIFIER UNIT

Receiver type, to remove destructive entrainment from vapor lines

Applications for the receiver-type purifier recently added to company's Hi-eF line include the protection of turbines and steam engines by removing damaging slugs of entrainment; use in exhaust steam installations where it is necessary to remove oil and other entrainment; and removal of condensate from compressed air systems. Among advantages claimed for the purifier are low initial cost, a self-cleaning action and careful fluid dynamics designing to provide for handling extreme velocities efficiently and reduce pressure drop.

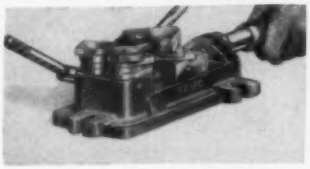
Entrainment laden vapor enters the receiver at the inlet and drops suddenly in velocity, causing most of the entrainment to drop to the bottom of the drain. Vapor then passes into a multi-stage purifier on the inside of the drum which removes virtually all remaining entrainment. After leaving the bottom of this purifier, the clean steam passes through the receiver outlet.

The new units have forged steel flanges and welded steel bodies and are made in sizes from 4 to 16 in. V. D. Anderson Co.

2—UNIVERSAL SCREW VISE

Made in Sweden; is designed to hold irregular objects securely

Anyone who has locked a round or tapered object in a vise knows the trouble of getting a tight hold without damaging the work. The Sevo Vise has jaws that are a series of machined and ground flat plates which hinge or swivel in any desired direction to coordinate with the shape of the held object. These jaws can be moved in relation to each other and the work piece can rest on a contact surface underneath. By turning the main screw the locking jaws position themselves and can then be locked to



retain their direction position, and the tightening screw is said to require only a slight turn to grip the object tightly. Vise jaws are precision ground Swedish steel. In two sizes, distance between jaws is 2½ and 5 in. DeWilde-Jones, Inc.

3—D-C TESTING INSTRUMENT

Permits faster checking of winding insulation for d-c armatures

Here's a new d-c winding insulation tester for d-c armatures, series field coils and low-impedance a-c stator coils. According to manufacturer, it will detect and aid in locating faults in turn-to-turn, coil-to-coil, and winding-to-ground insulation in d-c armatures of any size and rating. It is designed for testing large motors and generators.

The tester consists of a repeating type, surge-voltage generator which operates 60 times a second and a cathode-ray oscilloscope, all in one cabinet. A fixture is provided for applying test voltage to the commutator of the armature being tested. Company says this tester can check an entire armature in 3 or 4 min, because the operator has merely to glance at the oscilloscope screen to see if the surge wave shown is of proper shape and amplitude. A variance indicates a fault in the tested armature. Tester is 20 in. wide, 30 in. deep and 48 in. high and weighs 800 lb. It operates on a power supply of 230 v 60 cycles and is three-wire single-phase fused for 30 amp. Special Products Div., General Electric Co.

5—ALL-PURPOSE LUBRICANT

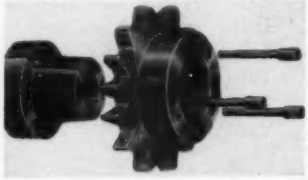
Bentone type, for use on water pumps, wheel bearings, universals and industrial equipment

Produced in grades from No. 00 to 3, Multiplex Lubricants are made with a bodying agent that gives them complete stability under all service and storage conditions. They are said to have no melting point and retain lubricity and adhesive characteristics under all temperature conditions normally encountered. While insoluble in water, they absorb moisture when in service without losing adhesive or lubricating qualities, manufacturer points out, and are suggested for use wherever water or moisture is a problem. Hood Refining Co.

6—HUB SPROCKET

Has interchangeability feature, to eliminating reboring for fit

This sprocket is designed to fit company's QD V-belt sheave hub without

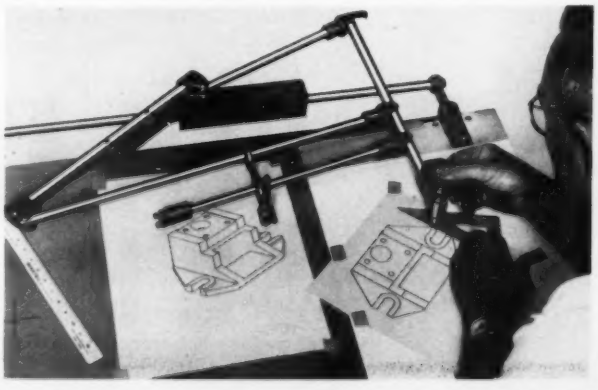


4—DRAFTING MACHINE

For quick, precise rendering of isometric and dimetric projections

The Vibax is expected to increase the productivity of trained isometricians and to enable draftsmen without previous experience in this work to produce isometric drawings with a minimum of instruction. It is lightweight and built for attachment to any drawing board without interfering with existing equipment.

To make an isometric drawing the operator follows the lines from an ordinary drawing by means of a tracer point on the Vibax linkage — and simultaneously a pencil draws the isometric view. The finished drawing is described as full-sized, with ellipses correctly proportioned, lines at proper angles, of correct length and joining at corners. Indamer Corp.



Better Steam Flow with Crane Stop-Check Valves

900 and 1500-Pound

Crane Y-Pattern Globe Stop-Check with Butt-Welding Ends. In 900- and 1500-Pound pressure classes; for temperatures up to 1000 deg. F. max. Sizes 6 to 12-inch.

PRESSURE-SEAL BONNET DESIGN IN GLOBE AND ANGLE PATTERNS

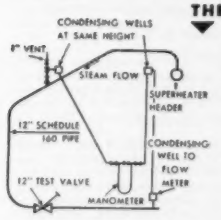
Performance on your boilers is a *known quantity* with these valves—scientifically predetermined by Crane. Conclusive tests show they operate with lowest possible pressure drop.

Better steam flow is assured by smoother, non-restricting interior design, combined with the exclusive Crane *aspirator-action* principle which provides faster and higher disc lift.

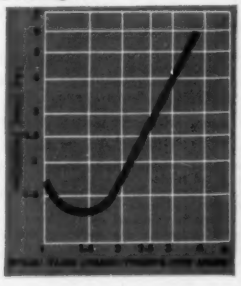
Inspection and Servicing No Problem—No long-time shutdowns with these Crane Stop-Checks! Simplified construction reduces inspection and servicing to a minimum. The most compact in their class, Crane Stop-Checks can be taken down and reassembled easily and quickly, without special tools. For example, unbolting the yoke clamp provides free access to pressure-seal assembly.

As proved in actual service, the Crane Pressure-Seal Bonnet design is the most dependable for high temperature—high pressure stop-check valves.

TYPICAL TESTED PERFORMANCE IN A CENTRAL STATION



THE TEST—Piping from boiler, and manometer piping used for testing 1500-Pound Crane Pressure-Seal Bonnet Globe Stop-Check in main steam line of a central station operating at 900 psi, 900 deg. F.



THE RESULT Performance curve shows substantially lower pressure drop than demonstrated by other valves in similar service.

HOW CRANE RAPID-ACTION HIGH-LIFT DISC WORKS

As shown below, a specially designed external pressure-equalizing pipe connects chamber above disc with outlet end of valve body. Under flow, this pipe acts as an aspirator, relieving pressure above disc to permit rapid maximum disc lift. On flow reversal, aspirator pipe admits higher pressure to top of disc chamber, aiding the disc to close quickly.

Cross-section 900-Pound Pressure-Seal Bonnet Angle Stop-Check.

CRANE CO.

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VALVES • FITTINGS • PIPE • PLUMBING • HEATING

need for reboring of either sheave or sprocket. It is taper-bored to receive the tapered hub. Bolts are provided to pull the sprocket onto the tapered split hub for a tapered drive assembly and a positive press fit on the shaft. Tapped holes in the sprocket permit the use of pull-up bolts as jack screws to break the tapered fit when dismounting the sprocket. A set screw over the keyway holds key in position. Sprockets are stocked at factory in ½ in. pitch through 1¾ in. pitch. Fort Worth Steel and Machinery Company.

7—STEAM TURBINES

Multi-stage, mechanical drive, in 200 to 5000 hp ratings

The Types DP, DR, DRV AND DRVX have been designed to cover a wide range of industrial applications as well as for power generation. The Type DP, rated from 200- to 3000-hp, is intended for driving pumps, compressors, fans, blowers. It has a hydraulic governor providing a 30 per cent speed range and 6 per cent speed regulation.

The Type DR (200- to 5000-hp) is built for applications requiring wider speed range, greater accuracy of control and greater capacity. Its oil-relayed governor makes possible a speed range up to 6 to 1, with only 4 per cent regulation and ½ per cent steady state speed variation, company says, adding that this accuracy permits smooth parallel operation of a-c generators. This turbine's speed range is sufficient for handling all types of variable speed pumps, fans, compressors, blowers or stokers.

The Type DRV (200- to 5000-hp) utilizes automatic sectional valves linked to the oil relay governor, an arrangement minimizing throttling losses under fluctuating load factors and improving overall heat cycle efficiency, according to manufacturer.

The Type DRVX is designed for application where process steam is desired at a definite, steady pressure. Steam is extracted from one intermediate stage of the turbine at a pressure held constant even when the load on the unit fluctuates and the flow of extracted steam varies. Exhaust steam may be condensed or applied to process requirements along with extracted steam. Turbine Dept., General Electric Co.

8—MOTOR-GENERATOR SETS

High cycle type; power electric grinders, buffers, other hand tools

Designed to convert 60-cycle current to 180-cycle and 360-cycle frequencies are these new mono-coil high frequency motor generator sets. The sets are self-exciting and have built-in voltage regulation to automatically compensate for fluctuations in voltage to the load. Electric Machinery Mfg. Co.

9—STEP CONTROLLER

For controlling multiple stages of refrigeration capacity

Although designed for refrigeration compressor applications, this pneumatic step controller may be applied to many sequence control problems. Capacity control is accomplished by starting and stopping compressors in sequence, loading and unloading cylinders, or a combination of both.

The unit is available in 4-, 6-, 8- or 12-switch models. Each single-pole, double-throw switch is operated by a pair of cams on a shaft which is rotated by a pneumatic piston in response to a pneumatic temperature or pressure measuring instrument. The "on" and "off" points of each switch are individually adjustable over the entire range of operation.

The controller has a current failure solenoid which exhausts air from the piston, returning all switches to their normal position whenever current is interrupted. An adjustable time delay, providing up to 12 min for a complete piston stroke, is used to assure sequence starting regardless of demands of the controller, when power is restored.

The unit is mounted on a sub-panel inserted in a metal cabinet. It is ordinarily operated by a thermostat in the chilled water line, or by a pressure controller actuated by the suction pressure. Johnson Service Co.

10—DRY SCRUBBER PURIFIER

With two-stage separation, for use where high quality vapor is a must

Said to be capable of delivering vapor containing 1 ppm solids or less, this new unit is designed to provide upflow operation in pressure vessels such as steam drums. It is said to eliminate need for auxiliary baffles within the drum.

Primary stage separation is accomplished by a rectangular-shaped anti-turbulence shield, which blocks direct contact of turbulent liquids and spray with the secondary separation chamber behind the shield. The shield consists of a four-wall chamber with corners offset and overlapping the ends of the side-plates and this construction lets the vapor pass around the plates of the secondary unit while deflecting splashes and spray away from the secondary unit.

Secondary separation is by means of either upflow or downflow purifiers within the anti-turbulence shield. Installation of the dry scrubber purifier is made to the distributing pan or header within the drum. Several units may be installed to one pan to distribute takeoff of vapor. The Centrifix Corp.

11—SPEED CONTROL SYSTEM

For operation from polyphase or single-phase a-c circuits

Fundamentally a Ward-Leonard system of speed control, this consists of three units — a motor-generator set, a controller, and a drive motor, any of which may be mounted any distance from the others and in any position. A single controller provides 16 forward and 16 reverse steps of speed adjustment of 150 rpm each to a total of 2400 rpm and provides full dynamic braking. A vernier rheostat may be connected in the circuit if finer adjustment is required.

Each rotating unit is of company's Stream cooled design and glass insulation is used, where practical, to provide compactness and minimum maintenance. Excitation is by a full-wave rectifier of the Tungar type. Sizes are ¾ through 3 hp for operation from polyphase circuits and through 1½ for operation from single phase circuits. Baldor Electric Co.

CATALOG LIBRARY

This monthly list of the latest standard catalogs and bulletins is designed to aid the engineer in maintaining his permanent catalog file of engineering data. The items listed, unlike those under Helpful Bulletins, will appear each month except for additions and deletions determined by space requirements or by the manufacturers issuing the bulletins. Use the Helpful Bulletins coupon in requesting these copies.

BOILERS AND AUXILIARIES

201 Steam Boilers — Form SG 128-749 is a 12 pp catalog illustrated with photos of steam boilers for processing and heating, ranging from 15 to 500 hp and 15 to 200 psi. Includes diagrammatic cross-section of four-pass design characteristic of manufacturer's boilers. Cleaver-Brooks Co.

202 Re-Circulation Steam Generator — Here's a 6-pp folder on a controlled re-circulation steam generator, describing its development and uses, such as applications where steam is required in remote locations, where demands are intermittent, or load fluctuating. Explains operation, features. Combustion Engineering-Superheater, Inc.

203 Packaged Generators — Bulletin SB-38 presents company's Keystone model. Photos and sketches show complete unit, pressure element and details of its compact design. Gives advantages of two-drum water boiler, three-pass gas travel, automatic gas or oil burner. Erie City Iron Works.

204 Shop-Assembled Boiler — Eight-pp Bulletin G-72 introduces company's new integral furnace boiler. Describes and illustrates its economy, ease of installation and connection, flexibility, minimum space requirements, efficient combustion, fast steaming. The Babcock and Wilcox Co.

205 Dowtherm Vaporizer — Bulletin No. 48-2, describing manufacturer's Type "A" Dowtherm Vaporizer, tells how this unit is designed to evaporate Dowtherm to provide dependable operation at maximum temperatures. The Wickes Boiler Co.

206 Tube Expanders — Bulletin 380, 8 pp, covers manufacturer's line of tube expanders for maintenance of high pressure boiler tubes, superheaters, economizers, circulating tubes, steam generators, other equipment. Thomas C. Wilson, Inc.

207 Rotary Tube Cleaners — Bulletin R-105 presents air and water driven rotary tube cleaners and cleaner accessories. Illustrates several models and heads, discussing special features. Roto Div., Elliott Co.

208 Streamlined Baffle Walls — Bulletin BW-44, 20 pp, describes company's baffle walls, showing their application to modern boilers and for modernising existing units. Fully illustrated with photos and drawings covering installations, remodeling designs. The Engineer Co.

209 Air Preheaters — Illustrated Bulletin A-11610, 8 pp, defines air preheat and explains its benefits in terms of increased efficiency and capacity and flame stability. Provides general description of company's preheater, discusses its application to boiler plants. The Air Preheater Corp.

210 Soot Blower Head — Illustrated Bulletin 485, describes a rotary soot blower head for improved boiler cleaning. Explains how head is designed to give maximum blowing pressure, is rugged, easily serviced, economical. Vulcan Soot Blower Div., Continental Foundry & Machine Co.

211 Double-Walled Tubing — Technical Bulletin 1950, 12 pp, presents tubing designed for conditions where single-walled tube can't withstand simultaneous attack from two types of corrosive media. Describes and illustrates construction, illustrating possible metal combinations. Explains tubing's use in ammonia refrigeration, boil-

REPEAT ORDERS are the "Proof of the Pudding"

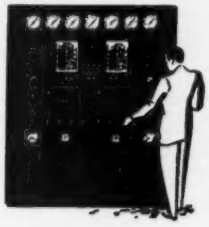
You might try something new because you believe it good. But you don't often buy it again until you've had proof that performance lives up to promises.

So it was with the important central stations on the list. They tried Vulcan Automatic Soot Blowing Systems on faith. They placed repeat orders after experience had proved that Vulcan would:

1) Clean boilers better because the system is engineered for effective blowing in even the least accessible passes. This means higher boiler efficiency, less fuel burned per pound of steam generated.

2) Use less steam or air in blowing because each boiler operates for exactly the proper cleaning interval and no more. Saving steam or air saves money.

3) Save labor because the entire system is operated by pushing one button at the panel. This frees men for other duties, improves operation and cuts operating costs materially.



Write for Bulletin 483—the story of modern Vulcan Automatics.

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Chicago District Electric Generating Company	3 orders
Cincinnati Gas & Electric Company	2 orders
Consolidated Edison Company of New York	8 orders
Duquesne Light Company	3 orders
Long Island Lighting Company	5 orders
Metropolitan Edison Company	3 orders
Monongahela Power Company	2 orders
New York State Electric & Gas Corporation	2 orders
Pennsylvania Electric Company	5 orders
Pennsylvania Power & Light Company	3 orders
Philadelphia Electric Company	5 orders
Public Service Company of Indiana	2 orders
Rochester Gas & Electric Company	4 orders
Staten Island Edison Company	2 orders

"Proof of the Pudding" lies in repeat orders placed by these important utilities for Vulcan Automatic Soot Blowers.

VULCAN SOOT BLOWER DIVISION
Continental Foundry & Machine Company
DUBOIS, PENNSYLVANIA

VULCAN *Automatic Soot* **BLOWERS**

ers, steam generators and other applications. Discusses heat transfer properties, high temperature use. Also discusses prevention of galvanic corrosion. Bridgeport Brass Co.

212 Tube Expander — This 2-pp bulletin introduces a simplified tube rolling control for expanding condenser and heat exchanger tubing — a precision instrument for heavy duty service. Crane Packing Co.

WATER CONDITIONING

214 Water Conditioning Information — Here are three informational bulletins. No. 28X7446 describes a simple way to determine total hardness in water, illustrating procedure. No. 28X7559 gives an analysis of the hot process-hot zeolite system, telling results to be expected. No. 28X7466 discusses current status of embrittlement in boilers, explaining causes and telling recent developments in control methods. List bulletins wanted. Allis-Chalmers Mfg. Co.

215 Modern pH and Chlorine Control — This 100-pp booklet gives details of company's color comparators and equipment in water testing and control of boiler and industrial process water, also technical information on meaning of pH control, electrometric and colorimetric methods of determining pH and impurities in water; applications of water control in air conditioning; treating boiler feed water. W. A. Taylor & Co.

216 Water Softeners — Bulletin WC-102 is a 36-pp presentation of recent developments in hot-process water softeners. Explains boiler plant troubles caused by various impurities in water, outlines 12 methods of treating water, describes reasons for the popularity of the hot-process method, explains chemistry of hot-process water softening. Graver Water Conditioning Co.

217 One-Minute Water Tests — Rapid, simple and accurate tests for determining water hardness are described in Bulletin 1RE50. Procedures, reagents, and equipment are described. Tells how tests determine water hardness, hardness due to calcium alone and hardness due to magnesium alone. Hall Laboratories, Inc.

218 Boiler Water Treatment — Bulletin 47, 8 pp, defines internal treatment of boiler water and tells its advantages in softening, sludge conditioning, stabilization. Explains company's system, including the chemicals used. National Aluminate Corp.

219 Ion Exchange Systems — "Amberlite Monobed Deionization" is a 12-pp miniature textbook covering history, performance, and potential uses of Monobed ion exchange systems in water-conditioning, chemical processing and other industries. Reactions of various combinations of exchanges are explained. Also discussed are costs, quality of product, and rinse requirements. The Resinous Products Div., Rohm & Haas Co.

220 Chemical Treatment of Water — Bulletins describing various methods of chemical water treatment, including company's Coravol process, are available. Coravol is part of a complete technical service which provides special chemical formulas for boiler feed water, foam prevention, hot water supply, refrigerating brine, cooling and condenser water. Western Chemical Co.

221 Boiler Water Manual — Factual information on methods of applying chemicals in treatment of water for boilers is presented in 16-pp Standard Method 122. Discusses pretreatment of raw water, application of chemical feeding to pretreating operations and both constant rate and flow responsive feeding direct to boiler drum and to feed-water system, condensate returns, flushing. % Proportioneers, Inc.%

222 Water Softening Equipment — How problems caused by hard water can be offset by water softeners is explained in Bulletin 2386, 12 pp, describing ion exchange equipment. It covers in detail downflow, upflow and gravity zeolite water softeners. The Permutit Co.

223 Water Treatment — Bulletin 5000, 24 pp, explains the reasons for boiler water treatment and tells services offered by company in providing formulations for individual plant requirements. Covers pre-treatment, internal treatment, treatment application, blowdown adjustment, test control. Describes available equipment and includes reference bibliography of literature on specific formulations. Dearborn Chemical Co.

224 Boiler Corrosion — A 12-pp article discussing cause and prevention of corrosion in boiler systems is presented in Betz Technical Paper No. 111. The corrosive effects of oxygen, carbon dioxide, ammonia, hydrogen sulfide, acidity, physical factors are evaluated. W. H. & L. D. Betz.

225 Zeolite Water Softeners — Publication 4530, 16 pp, presents hydrogen zeolite (cation exchange) water softening equipment. Gives complete description of the process and the field of application, showing advantage of hydrogen zeolite softening and its relation to sodium zeolite softening process. Cochrane Corp.

226 Corrosion Treatment — "Corrosion Protection of Steam and Condensate Return Systems" is a folder on amine treatment for boiler and condensate systems. This treatment is described as affording surface protection of the metal as well as raising pH value of condensate. The Bird-Archer Co.

227 Slurry Type Softener — Six-pp Bulletin W-212-B6 describes a slurry type precipitating softener and coagulator in which energy for floc preparation is mechanical, explaining and illustrating flow circuit. Question-and-answer appraisal of system. Worthington Pump and Machinery Corp.

228 Organics in Water Treatment — Here's a folder describing need for organics in altering nature of sludge to make it non-adherent. Covers theoretical and practical considerations involved in use of organics; tells how they overcome problems of sludge. Power Chemicals Div., E. F. Drew & Co., Inc.

ELECTRICAL

230 Power Factor Correction — Examples showing basic considerations in the improvement of system power factor are contained in Bulletin O5B7465. Points out advantages of improving plant power factor and advisability of keeping load power factor up to 0.8 lagging or higher; tells how the effects of low power factor can be corrected. Allis-Chalmers Mfg. Co.

231 Synchronous Motors — High speed synchronous motors are described in Bulletin PB 5600-1. Includes descriptive matter, photos showing features. Elliott Co.

232 Care of A-C Rotating Equipment — To promote intelligent and consistent maintenance of electrical machines, company offers Bulletin O5R7417, a series of articles by Fraser Jeffrey. Contents of the 24-pp booklet cover preventive maintenance and machine repairs, drying moist insulation, measuring insulation resistance. Allis-Chalmers Mfg. Co.

233 Buyers' Manual on Motors and Control — Fifty-pp Catalog GEC-1009 presents buying information on a carefully selected group of motors, motor starters, control accessories and electronic control. Ratings listed are those most frequently required. Excellent data on proper selection is provided. Illustrated. General Electric Co.

234 Co-ordinated Protection of Motors — The interlinked protection of circuits, motors and personnel is explained in 12-pp Bulletin DB-4673 on high-voltage combination starters. Because almost every 2300/4800 v power system can produce high currents under short-circuit conditions, booklet stresses this interlinked protection, covering three classes of combination motor starters: an air-break type for squirrel-cage induction motors; a starter with oil-immersed contactor, and a combination synchronous motor starter. Westinghouse Electric Corp.

VALVES, TRAPS, PIPING

235 General Service Valves — Bulletin E-160, 16 pp, describes and illustrates design and construction of company's quick-operating valves, explaining their application to blow-off service and on chemical process, soot blower, water column blow-down, and other types of pipe line. Includes dimensions, weights; prices. Everlasting Valve Co.

236 Popular Steel Valves — Condensed Catalog 104, 28 pp, describes and illustrates most widely used of company's cast and forged steel valves and the data presented for these valves is complete. Those listed are chiefly in the basic steam pressure classes — 150 to 2500 lb — and include globe and angle, gage, instrument, hydraulic and relief types, also strainers, and check, gate, non-return and blow-off valves. Explains design features. Edward Valves, Inc.

237 Valves, Fittings and Flanges — Catalog F-9 is a 400-pp, permanently bound reference book on drop forged steel valves, fittings and flanges for practically all piping needs at high and low pressures and temperatures. Provides ordering information on company's complete line, also much helpful engineering and application data; includes a section on products for refrigeration service. Fully illustrated, indexed. Available to qualified power engineers, please give your title. Henry Vogt Machine Co.

238 Valve Specialties — Included in 90-pp Catalog A-50 is complete ordering and engineering information on automatic pressure flow and liquid level controls for steam, air, gas, water, oil, other fluids. Sections are devoted to pressure regulators, altitude valve, pump governors and strainers; lever, float and motor operated valves, pilot valves; back pressure, relief and non-return valves, steam trap and air vent; liquid level controllers; solenoid valves. Includes capacity charts. Davis Regulator Co.

239 Pressure Reducing Valves — Selection and engineering data on pressure reducing valves, including those for remote control of reduced steam or water pressures, are presented in 12-pp Bulletin 477-A. Northern Equipment Co.

240 Safety Valve Engineering Data — How company's safety valve works and its operating advantages are explained in Bulletin 707. Includes dimensions on valve types, tables on superheat correction factor. Manning, Maxwell & Moore, Inc.

241 High Pressure Gate Valve — Described in 4-pp Form DH-273 is a forged steel gate valve designed for long service and low cost maintenance. Working pressures, sizes and prices listed. R-P & C Valve Div., American Chain & Cable Co., Inc.

242 Forged Steel Valves — Form 800-A describes 600-lb forged steel valves for high line pressure and temperature applications. Covers both inside screw and OS&Y union bonnet gate types, giving sizes, prices. Chart shows trim metals for different services. The Ohio Injector Co.

243 To Get at those Valves — This little folder describes a sprocket rim with chain guide. The rim adjusts to fit all valve wheels. Babbitt Steam Specialty Co.

244 Steam, Air and Gasoline Traps — Catalog 751, 32 pp, is a 32-pp ordering book on traps. It's fully illustrated, provides capacity tables, installation diagrams and a section containing data, charts and formulas for determining proper size trap for specific applications. Covers thermostatic steam traps for pressures to 225 lb; expansion steam traps for pressures to 250 lb; weight-operated traps for steam, air, gasoline, pressures to 1500 lb; piston-operated steam traps for pressures to 650 lb. W. H. Nicholson & Co.

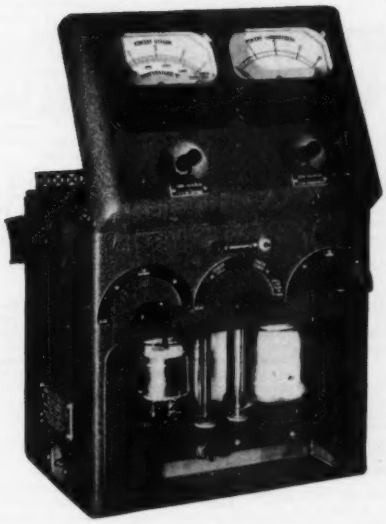
245 Trap Data — Here's a 12-pp condensed catalog giving information and prices on steam and air traps. Lists cast

Mobilizing BTU's

Now that the "heat's on" for record production, the calls are increasing for the services of the Cities Service Heat Prover. This scientific instrument gives an accurate, instantaneous and continuous picture of combustion conditions in all types of furnaces.

You'll readily be able to calculate any oxygen excess, waste combustible matter, and potential fuel savings. The results are like an accurate "diagram" of corrective measures needed to conserve heat units for consistently higher production at lower cost.

You'll see profit in applying the Cities Service Heat Prover . . . *not an instrument you buy, but a service we supply!* Call or write your local Cities Service office about arrangements. Or simply return the coupon today.



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semi-steel, and forged steel inverted bucket traps, compound steam traps, ball float air traps, Y-type strainers and internal check valves. Provides data on calculation of condensate loads and a selection of traps to handle these loads, also a full-page capacity chart. A parts list is included. Armstrong Machine Works.

246 Steam Trap Reference Manual — Bulletin T-1740, 24 pp, tells why and where steam traps should be used; explains desirable trap features. Advantages of company's impulse steam traps are described, their operation illustrated. How to figure traps sizes and how to size condensate return lines are told and capacity and pipe dimension charts and thermodynamic properties of saturated steam included. Also provided are installation and operating suggestions, prices. Yarnall-Waring Co.

247 Steam Traps and Temperature Controls — Here is a comprehensive catalog comprising many of company's bulletins on steam traps and related equipment, including an illustrated steam trap selection chart. Provides data on boiler steam traps, air eliminators, thermostatic steam traps and air vents, inverted bucket steam traps, temperature regulators and cooling controls, steam and water mixers, thermostats and strainers. Sarco Co., Inc.

248 Strainers and Separators — Bulletin R-46-50A is a 16-pp catalog on T-type strainers, suction strainers, multiflow and receiver separators. Contains dimensions, weights, prices. Shows how several types have been redesigned for increased efficiency. American District Steam Co.

249 Safety Head Catalog — Section 10, Part 1 of Catalog 54, 52 pp, is written in non-technical language and fully illustrated with cutaways and installation photos, charts and tables covering almost any phase of safety head information desirable. Tells where safety heads can be used and how to use them. Tells how to choose safety head assemblies and rupture discs. Includes tips for lowering temperature at point of safety head location. Black, Sivalls & Bryson, Inc.

250 Design Properties of Pipe — This 12-pp booklet consists of tables listing pipe sizes and wall thicknesses currently established as standard, plus what is believed to be a most complete tabulation of dimensional properties of commercially available sizes of steel pipe. Tube Turns, Inc.

251 Piping Pointers — This is company's highly popular 36-pp manual covering fundamentals of sound piping practices. Discusses various types of valve designs and how each should be used. Pictures and names more than 80 fittings and contains illustrated how-to-do-it features. Includes 8 pp valve selection guide. Crane Co.

252 Handbook on Fittings and Flanges Catalog wf-1950, 88 pp, gives working information on seamless carbon steel welding fittings and forged steel flanges. In addition to presenting standard schedules with specifications, list prices and sizes, book gives information on dimensional tolerances; American standard flange facings with dimensions; thread standards and threading practice; service pressure ratings, physical and chemical requirements for flanges, nuts and bolts; plus sizes and wall thicknesses of welding fittings. Grinnell Co., Inc.

253 Unions and Fittings — Twelve-pp Catalog 50 covers manufacturer's line of unions of all types, elbows, tees and fittings. It describes and illustrates special construction features and other advantages. E. M. Dart Mfg. Co.

254 Flanges for Severe Service — This 4-pp bulletin describes a flange specially developed for services involving severe abrasion and corrosives, and for suction and discharge service. Goodall Rubber Co.

FUEL OILS, LUBRICANTS

255 Fuel Oil Treatment — By text and sketches, this folder points out undesirable conditions in the storing, pumping, heating and burning of industrial fuel oil and correction of these conditions by company's treatment. E. F. Drew & Co., Inc.

256 Air Compressor Lubrication Manual — Valuable information on air compressor maintenance is contained in this 40-pp book. Subjects treated include compressed air, compressors and related equipment, lubricating systems, compressor oils and applications, lubrication requirements, operating hints, oil requirements, storage and care of compressor oils, safety precautions. Cities Service Oil Co.

257 Diesels, Their Fuels and Lubricants — This 46-pp book gives practical information on diesel engines, covering their history and economics as well as design characteristics and operating principles. Classification of diesels according to speed is explained. Other chapters cover injection systems, combustion chambers, also lubricating systems, and diesel oil purification and filtration. Includes discussion of fuel and lubricating. Sinclair Refining Co.

258 Viscosity of Fluids — The larger significance of viscosity is discussed in Nos. 5 and 6, Vol. 36 of Lubrication, a technical publication. In six parts, the first illustrates simplest conception of streamline flow between two surfaces having relative motion. A series of torsion viscometers shows how viscosity acts and may be measured. Part II covers streamline flow in capillary and other small tubes. Part III covers turbulent flow in pipes. Part IV discusses effects of temperature and pressure on viscosity, and Part V includes viscosity index. Part VI gives brief reference to nature of plastic flow. The Texas Co.

INSTRUMENTS AND CONTROLS

259 For Centralized Control — Bulletin 100 presents compact Mini-Line equipment suited to control board arrangement which concentrates vital operating information and controls for one or more boilers, turbines or process units before a single operator. Describes and illustrates vertical-scale indicator units, selector valve, remote manual relay. Bailey Meter Co.

260 Remote Reading Flow Meters — Data Book 702, 32 pp, fully illustrates and explains flow measurement problems and offers suggestions for their solution. Meter bodies, differential devices and reading instruments are fully described. Republic Flow Meters Co.

261 Flow Meters — Bulletin 400-F2, 8 pp, features company's meter for measurement of steam, air, or gas flow in 1 or 1¼ in. pipe lines, and designed for installation directly in the line being metered. Illustrated with photos of meter, sectional and dimensional drawings, bulletin discusses meter's advantages. Builders-Providence, Inc.

262 Putting the Ratio Totalizer to Work — Twelve applications of company's ratio totalizer in automatic control circuits are shown in 8-pp Bulletin 5450. This is a pneumatically operated control mechanism for combining input control pressures and spring forces to produce a single output control pressure. Hagan Corp.

263 For Practical Men — This 24-pp pocket-size booklet presents insulation testing in simple language. Packed with maintenance hints, explains electrical insulation, tells how it can be tested and what makes it go bad. It describes the Megger insulation tester and justifies its cost in long run economy. James G. Biddle Co.

264 Air Locks — Illustrated Bulletin S-31, 2 pp, describes company's air locks and trip master controls for holding regulating and control valves in position during failure of air supply. The Swartwout Co.

265 Flow Tubes — Catalog 80, 4 pp, presents engineering data on a primary element for measuring, regulating, controlling fluid flow. Tells how flow tubes are designed, function. Foster Engineering Co.

266 Control Equipment — General Catalog 001, 30 pp, is devoted to measuring and control equipment for water and sewage works, power and processing industries. Describes in detail: venturi tubes and meters, controllers, gages, manometers, pilots. Simplex Valve and Meter Co.

267 Steam Calorimeter — Bulletin 118 discusses an improved U-path calorimeter combining a throttling, separating and re-evaporating calorimeter in a single chamber. Explains and illustrates construction and operation of the unit and quotes letters from users of this type of equipment. Ellison Draft Gage Co., Inc.

268 Metered Liquid Handling — Bulletin OG 400 contains 12 pp of selection and ordering data on positive displacement type meters. Explains and illustrates operation, giving specifications, dimensions. Also presents several types of registers, register extensions, strainers and remote registration unit. Includes table of material recommendations for meter parts for use with 200 different liquids. Rockwell Mfg. Co.

269 Pressure Regulator — Bulletin 1-B, 8 pp, discusses design, operation and applications of a super-sensitive pressure regulator; shows typical installations. Also covers a compound regulator for controlling back pressure relief valve and high pressure make-up valve. Atlas Valve Co.

PACKINGS

270 Pump Packings — Packings for reciprocating and centrifugal pumps are described in this folder. Covers packings for practically all services. Johns-Manville.

271 Teflon Packings — Form AD143 offers 8 pp of information on Teflon packings and gasketing material, giving properties, typical and special applications. Includes chapter on toxicology of Teflon at extremely high temperatures. The Garlock Packing Co.

272 Manual on Packings — Containing 84 pp of engineering and ordering information, Catalog 40 covers packings for practically every service. Includes packaging recommendation charts, conversion tables. The Belmont Packing & Rubber Co.

273 Packings and Gaskets — Catalog P-100C, 32 pp, covers 95 most popular packings and gaskets in company's line, furnishing details of construction, service recommendations and size information. Includes charts showing specific recommendations for a wide variety of applications. Packing Div., Raybestos-Manhattan, Inc.

274 Long Wearing Piston Packing — Form 4502, 8 pp, stresses use of company's composition cups for packing the pistons of air and hydraulic cylinders and reciprocating pumps. Engineering information covers properties, textures available, temperature, pressure data. Darling Valve & Mfg. Co.

275 Packing Rings — Engineering data on company's Simsite Graphitic snap rings of non-metallic composition for packing liquid end pistons of reciprocating pumps is provided in illustrated Bulletin R112. Covers properties of Simsite, forms of packing spaces, ordering information needed, installation procedure. Sims Pump Valve Co., Inc.

COAL, ASH, AND WASTE HANDLING

276 Spreader Stoker Selection — Fourteen-pp Form F-520-A10M is intended to help those choosing a spreader stoker to get the most for their investment, and it points out many factors to be considered. American Engineering Co.

277 Spreader Stoker Data — This is a file of three illustrated bulletins on spreader stokers. The first discusses seven reasons for selecting these stokers and describes their design, construction and operation; the second, dumping grates, the third, installations. Riley Stoker Corp.

(Continued on page 128)

Nipple that failed after one year in main condensate line.
Corrosion of threaded area caused leakage in return line.
these parts were destroyed by RLC
Carbonic acid corrosion eats right through cast iron elbow.
Nipple shows characteristic pitting due to dissolved oxygen.

prevent Return Line Corrosion with Dearborn Formula 700 or 702

These destroyed parts were the victims of *return line corrosion.* If your maintenance costs are high because leaking or clogged return lines require replacement—if rusty condensate is coming back to your boilers—then it will pay you to use Dearborn Formula 700 or 702.

Return line corrosion is caused by oxygen and carbon dioxide. It can be effectively controlled thru the easy, inexpensive application of either the neutralizing amine-type treatment (Formula 700) or Dearborn's new filming-type amine treatment (Formula 702).

Your Dearborn Engineer is prepared to make specific recommendations on the use of Dearborn Formula 700 or 702 in your plant.

DEARBORN CHEMICAL COMPANY
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NOTE: Dearborn holds the basic patent (U.S. Pat. 2400543) for the use of *filming amines* for treating water.

WRITE FOR THIS BULLETIN

Write for Bulletin 5013 which outlines causes of return line corrosion and describes how it can be controlled by Dearborn Formula 700 or 702.

Dearborn Chemical Company, Dept. PG
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( ) Send a copy of Bulletin 5013
( ) Have a Dearborn Engineer call

Name.....

Position.....

Company.....

Address.....

City.....Zone....State.....

Dearborn
TRADE MARK REGISTERED
THE LEADER IN WATER TREATMENT AND RUST PREVENTIVES

POWER PLANT Construction News

Andalusia, Ala. — Gulf Naval Stores Co., Inc., Gulfport, Miss., turpentine, rosin, and other naval stores, plans boiler house at proposed new plant at Andalusia, where tract of land has been acquired. It will comprise several one and two-story buildings, to be equipped for sizable output. Cost reported in excess of $1,500,000. Work scheduled to begin at early date.

Birmingham, Ala. — Alabama Power Co., Alabama Power Bldg., plans expenditure of $55,700,000 during 36 mo. period, ending in 1953, for increased generating facilities, including extensions in a number of existing plants and installation of new equipment; and construction of new steam-electric station on site to be selected, to be equipped for a rating of 100,000-kw. Entire project will develop a gross generating capacity of 1,384,000-kw. At same time, approximately $12,200,000 will be expended for extensions in transmission lines and power substations.

Jonesboro, Ark. — Water & Light Dept., will carry out expansion in municipal steam-electric generating plant, including building extension and installation of new 7500-kw turbine-generator unit, boiler, and auxiliary equipment. Project reported to cost over $1,200,000. Burns & McDonnell Engineering Co., 95th and Troost Sts., Kansas City, Mo., is consulting engineer.

Los Angeles, Calif. — Archer-Daniels-Midland Co., 600 Roanoke Bldg., Minneapolis, Minn., linseed oil and other oil products, plans new branch plant at Los Angeles, where site has been acquired. It will consist of a main unit for production of special modified oils and varnish products. A boiler house will be built. Proposed to begin work soon and to have plant ready for service early in fall of 1952. No official estimate of cost announced — reported over $1,500,000.

Santa Cruz, Calif. — William Wrigley, Jr. Co., 410 North Michigan Ave., Chicago, Ill., chewing gum, plans boiler house at new plant at Main St. and West Cliff Dr., Santa Cruz, where site has been secured. Factory will consist of a main one and two-story building, approximating 147,000 sq ft floor space, with multi-story tower for processing service. Entire program will represent investment of about $3,000,000. Proposed to begin work before close of this year. Victor L. Charn, 4744 West Rice St., Chicago, is engineer.

Miami, Fla. — Florida Power & Light Co., 25 South Second St., has arranged financing in amount of $10,000,000 through sale of bond issue, proceeds to be used for expansion and improvements in plants and system, including generating stations, power substations, transmission lines and other operating facilities.

Bolton, Ga. — Atlanta Paper Co., 950 West Marietta St., Atlanta, Ga., corrugated paper and other paperboard products, plans power house at new paper mill at Bolton, where tract of land has been acquired. It will comprise several one and multi-story structures, to be equipped for sizable output. Entire project reported to cost over $2,000,000. Work is scheduled to begin soon.

Savannah, Ga. — Savannah Electric & Power Co., 27 West Bay Ave., plans expansion in local Riverside power plant, with installation of new turbine-generator, high-pressure boilers, and accessory equipment. Entire project is reported to cost about $4,500,000. It is understood that project will be carried out during 1952.

Council Bluffs, Iowa — Iowa Power & Light Co., 312 Sixth Ave., Des Moines, Iowa, has plans under way for new steam-electric generating plant in vicinity of Council Bluffs. Installation will include turbine-generator, high-pressure boiler, and auxiliary equipment. Cost reported close to $5,000,000. Black & Veatch, 4706 Broadway, Kansas City, Mo., are consulting engineers.

Versailles, Ky. — Standard Products Co., 2130 West 110th St., Cleveland, Ohio, metal stampings, molded rubber and plastic products for automotive and other service, plans boiler house at new branch plant at Versailles, where site has been selected. It will comprise several one-story buildings, with equipment and facilities to give employment to about 300 persons. Cost approximately $1,000,000. Work on superstructure will be placed under way soon.

Baldwin, La. — Gulf Public Service Co., New Iberia, La., plans new steam-electric generating station at Baldwin, where site is being selected. Project reported to cost about $3,500,000, with turbine-generator, high-pressure boiler, and auxiliary equipment. Work is scheduled to begin at early date.

Lake Charles, La. — Davison Chemical Corp., Charles and Fayette Sts., Baltimore, Md., industrial and technical chemicals, commercial fertilizers, etc., plans boiler house at new plant in vicinity of Lake Charles. It will comprise several large units for processing and production of synthetic fluid catalysts used in petroleum industry. Entire project is reported to cost about $7,000,000. Work will begin soon. Day & Zimmerman, Inc., 1700 Sansom St., Philadelphia, Pa., is engineer.

Detroit, Mich. — Detroit Edison Co., 2000 Second Ave., has arranged an expansion and improvement program to cover a period of 36 mos., including generating stations, power substations, transmission lines and other operating facilities. Plans are under way for a new steam-electric generating plant on St. Clair River, with a second such station near mouth of River Rouge. To provide for construction in part, company has arranged a financing approximating $25,000,000 through sale of notes.

Minneapolis, Minn. — Northern States Power Co., 15 South Fifth St., has arranged financing through bank loans in amount of $15,000,000, fund to be used in connection with current, 1951–52, expansion and improvement program, including generating facilities, power substations, transmission lines, and distribution system.

Meridian, Miss. — W. S. Dickey Clay Mfg. Co., Commerce Trust Bldg., Kansas City, Mo., sewer pipe and other vitrified clay products, plans boiler house at new plant at Meridian. It will consist of several buildings, with equipment for large output. Cost reported about $1,600,000. Work will begin at early date.

St. Joseph, Mo. — MFA Cooperative Grain & Feed Co., 429 Cherokee St., grain products, commercial fertilizers, animal feed, etc., plans boiler house at new plant on local site for production of commercial fertilizers. It will consist of a main one-story building and several smaller structures, with equipment for sizable output. Cost reported about $1,000,000. Work scheduled to begin at early date.

Omaha, Neb. — Omaha Public Power District, 17th and Harney Sts., is projecting plans for large steam-electric power plant on local site. Installation will include several generating units, high-pressure boilers and auxiliary equipment. Details are being determined. Entire development is reported to cost over $40,000,000.

Charlotte, N. C. — Lion Oil Co., El Dorado, Ark., refined petroleum products, plans power house at proposed new plant in vicinity of Charlotte, for production of anhydrous ammonia. It will consist of a series of multi-story structures, with equipment for large capacity. Entire project reported to cost $30,000,000. Company has arranged financing in that amount through RFC, and program has been approved by National Production Authority.

Canton, Ohio — Ohio Power Co., 301 Cleveland Ave., S. W., has authorized financing through sale of bonds and serial notes in amount of $22,000,000, proceeds to be used for expansion and improvements, including additional generating facilities, power substations, transmission lines and miscellaneous work.

Wooster, Ohio — Borg-Warner Corp., 310 South Michigan Ave., Chicago, Ill., steel products for automotive and other service, machinery specialties, etc., plans boiler house at proposed new plant at Wooster, where tract of land is being secured. It will comprise a main one-story structure, about 104,000 sq ft floor space, to be equipped for parts manufacture and assembling of electric-operated fuel pumps for jet engines for aircraft service. Entire project reported to cost about $3,000,000. Work will begin soon and is scheduled for completion next spring.

Holdenville, Okla. — Seamprufe, Inc., 412 Fifth Ave., New York, N. Y., nylon hosiery and other textile products, plans boiler house at new branch mill at Holdenville, where tract of about 25 acres of land has been secured. Project will comprise several buildings, with main unit of about 50,000 sq ft floor space. Entire program will represent a reported investment of about $1,000,000. Proposed to begin work soon, with plant to operate initially for manufacture of parachute cloth for Government.

Tulsa, Okla. — Public Service Co. of Oklahoma, 600 South Main St., is considering plans for new steam-electric power plant, exact location soon to be determined. Turbine-generator units, high-pressure boilers, and auxiliary equipment will be installed for large capacity. Cost reported over $9,000,000. It is understood that project will be carried out in 1952.

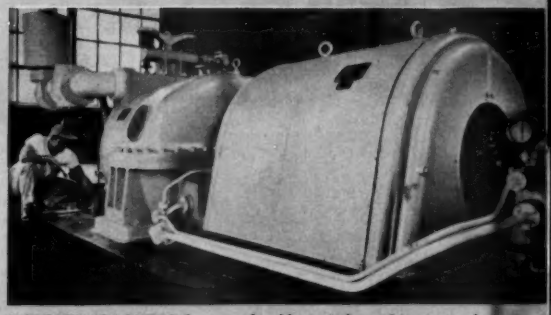
Pottstown, Pa. — Firestone Tire & Rubber Co., Akron, Ohio, automobile tires, tubes, and other rubber products, plans boiler house at proposed new branch plant at Pottstown. It will comprise several one and multi-story buildings, equipped for large output. Cost reported about $5,000,000. Proposed to begin work soon. Day & Zimmerman, Inc., 1700 Sansom St., Philadelphia, Pa., is engineer.

Charleston, Tenn. — Bowater's Newfoundland Pulp & Paper Mills, Ltd., Corner Brook, Newfoundland, plans power plant in connection with proposed new newsprint mill in vicinity of Charleston (Bradley County), where site has been secured. Project will consist of several large units for production, and is reported to cost approximately $45,000,000. Permission for project is being secured from National Production Authority, Washington, D. C. Completion is scheduled in 1953.

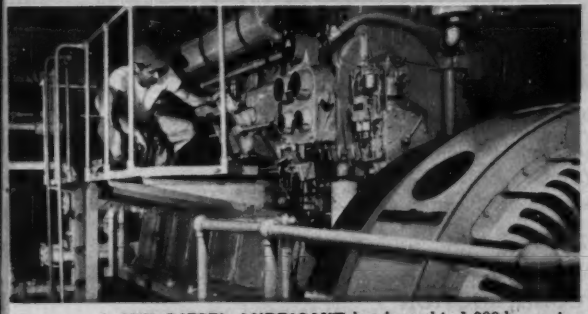
NANTUCKET ISLAND can't tie in with mainland power facilities and must therefore be entirely self-sufficient. To assure unfailing performance, the Nantucket Gas & Electric Company uses Sun lubricants exclusively. Also, engineers of the utility, of the diesel builders, and of Sun Oil cooperated to make possible a unique, three-way use of one inexpensive Sun fuel.

HOW SUN PROTECTS NANTUCKET'S POWER

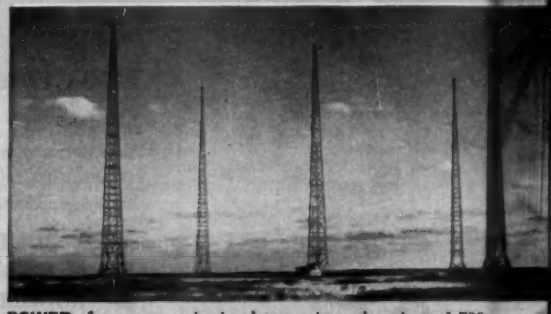
THE ISLAND'S POPULATION drops from around 16,000 to some 3,800 when the vacation season ends. With the power load fallen off so drastically, much of NG&E's equipment lies idle and subject to condensation during this extended time.



DESPITE IDLENESS for considerable periods, turbine journals, bearings and controls remain free at all times of sludge, rusting and corrosion—thanks to the protection of Sunvis 916. Its special metal-wetting additives displace any moisture that may be present.



A SUN DIESEL LUBRICANT has kept this 1,000-hp engine purring almost 15,000 hours. A single heavy, low-cost Sun fuel drives NG&E's diesel, fires its boilers, enriches its illuminating gas.



POWER for a new navigational transmitter, throwing a 1,700-mile beam for guiding aircraft, is supplied by Nantucket G&E—more evidence of the reliance placed on its Sun-lubricated plant.

For complete information about Sun's turbine and diesel oils, or for the services of a Sun representative, call the nearest Sun Office, or write to Dept. PP8

SUN INDUSTRIAL PRODUCTS

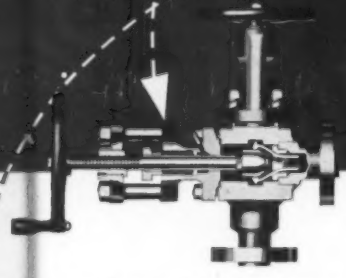
SUN OIL COMPANY, PHILADELPHIA 3, PA. • SUN OIL COMPANY, LTD., TORONTO AND MONTREAL

SUNOCO®

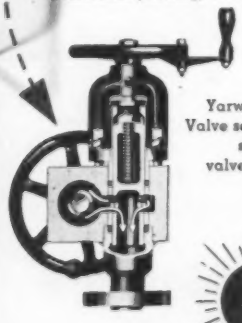
leading boiler makers say...

YARWAY

BLOW-OFF VALVES



Yarway Unit Tandem Valve sectioned through stellite-seat (blowing) valve. Open position.



Yarway Unit Tandem Valve sectioned through seatless (sealing) valve. Open position.

Leading steam boiler makers (names on request) standardize on Yarway Blow-Off Valves . . . for the same reasons that over 15,000 plants use them:

- UNIQUE DESIGN
- MODERN METALLURGY
- RUGGED CONSTRUCTION

} TROUBLE-FREE SERVICE

How these features will help your boiler operation is clearly explained in Yarway Blow-Off Valve Bulletins. Write for one, telling us your operating pressures.

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BLOW-DOWN TROUBLES...KEEP BOILERS ON THE GO

LETTERS TO THE EDITORS

FUTURE OF THE GAS TURBINE

THE VARIOUS articles describing the increasing interest in, and the use, of gas turbines in the United States during the last few years have been of great interest to me. During the next decade or two we shall undoubtedly see great development in the use of the gas turbine, comparable probably to the development in the use of the steam turbine in the early years of this century. At present the gas turbine is a very high-speed machine, not favorable to driving 3600 rpm alternators direct. As units increase in capacity, however, speeds will be reduced — as they were in the case of the steam turbine as they became larger — and eventually we will have gas turbines operating 3600 rpm alternators without the need for reduction gears.

It would be presumptuous of me or anyone else to try to predict the exact future of the gas turbine in our power development; whether or not it will eventually replace the steam turbine is something that only future years will disclose. In the meantime, it is quite possible that the steam turbine and the gas turbine can be made to work together in one system. Indeed, this possibility is already receiving a considerable amount of attention. By combining the gas and steam cycles it is possible that either a material improvement of the thermal efficiency or lower plant installation cost can be achieved. As reported in a recent issue of *The Steam Engineer* of London, one of the proposals receiving consideration is the use of the open-cycle gas turbine as an air preheater to the steam boiler, to increase the overall efficiency of the combined cycle.

Owing to the high rate of excess air necessary, to keep the temperatures in the gas turbine down to permissible values, most of the oxygen of the air is still left unburnt in the exhaust gases; and as the temperature range of the gases may be 700 to 1000 F, it can be used as combustion air supplied to the boiler furnace at about atmospheric pressure.

The gas turbine, therefore, is envisaged as a *topping* unit, similar to a back-pressure steam turbine superimposed on an existing system. Utilization in the boiler of the exhaust heat from the gas turbine means that this set is working with very small heat losses. The highest thermal efficiency for the combined plant is obtained when the gas turbine is designed to give a maximum output consistent with the efficiency of the steam cycle remaining sensibly constant. As reheat increases the output, it is advantageous, but regenerators and compressor intercoolers would appear to be superfluous. Higher permissible gas temperatures would give a greater rate of increase of thermal efficiency of the combined plant compared with a straight steam cycle.

Another scheme being considered is the use of the open-cycle gas-turbine-driven compressor electric-generator set as a super-charger for a *pressurized combustion* boiler, which would reduce materially the dimensions and overall cost, as well as to improve the overall thermal efficiency of the combined cycle.

In the case of the first scheme, i.e., using an open-cycle gas turbine to supply combustion air to a boiler furnace, and with steam conditions of 2500 psi, 1050 F, reheating to 1000 F and with 29 in. of vacuum, with 160 to 220 F feedwater temperature and the gas cycle with 1380 F inlet temperature, overall efficiencies of from 40 to over 44 per cent are indicated. The gas turbine would develop from 15 to over 35 per cent of the total output. In the latter case, however, the system would present many problems to the designer of the boiler, since very large surfaces would be required when 170 per cent excess air is contemplated.

While none of these schemes have actually been tried, they present interesting possibilities, and the interest in them at the present time constitutes ample proof that progress in power development has by no means diminished. I, for one, hope that future pages of POWER ENGINEERING will contain vigorous and intelligent discussion of these matters.

New York, N. Y. HOWARD GIBSON

POWER PLANT COMMUNICATION

MR. JARZEMBSKI'S excellent article on power plant communication systems in the September issue calls attention to an important element of modern power station design, one only too often given scant consideration. In a number of installations where loud speakers have been installed in power plants, the only criterion that seems to have governed the design of the sound system was that the speakers make as much noise as possible. In one notable instance where a splendid new central station was built near a fine residential area, the loud speakers in the boiler room made such a racket that home owners two blocks away complained about it. This could easily have been avoided if the speakers had been adjusted, as Mr. Jarzembski points out, to deliver sound intensities conforming to the location of each particular speaker.

With reference to other types of communication, I have seen at least one large central station where walkie-talkie radio sets were used for communication between men operating the coal handling system and other parts of the plant. This method of communication, naturally, would be useful only in very large plants.

Waban, Mass. J. C. WARD

ADJUSTING POWER FACTOR

REFERRING to Mr. Gusler's excellent article in the July issue of POWER ENGINEERING, I believe that some conditions he outlined might be profitably amplified.

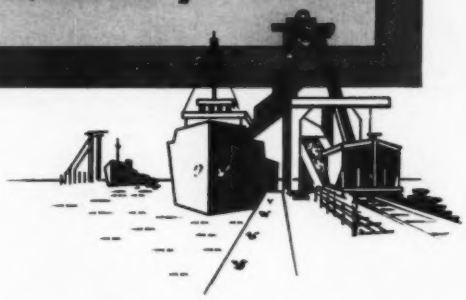
Considering "Step C — Adjusting Power Factor", we must remember that in many switchboard installations, exciters are connected in parallel to a common bus. In operating such an installation, load division between exciters is achieved by adjustment of the exciter field rheostats. When a spare exciter of the motor generator type, or the turbo-generator type is provided, a common bus is indicated. Alternating current voltage regulation is then obtained by installing a voltage regulator with several operating sections, one for each exciter. While this system is not the best, from a viewpoint of voltage regulation, there are many such installations, and like all things, this hook-up has its good points. One of these good points being that an alternator in the line can be excited from the common bus, regardless of the outage of one or more exciters. In a pinch, storage batteries can be used. Care must be taken not to overload the exciters in operation.

With excitation from a common bus, power factor equalization is accomplished by adjustment of the alternator field rheostats. Not all alternators are equipped with power factor meters, and in such cases where the meter is not installed, the main field rheostat is adjusted so as to allow the least current to flow in the stator circuit, consistent with the kilowatt load. In general it is best to operate with the main field rheostat as near the "out" position as possible, not only because of better voltage regulation, but so as to eliminate waste of direct current power in the rheostat. In Mr. Gusler's article, there seems to be some confusion between a reverse power and an overload relay.

Because of design limitations, or, for that matter, the ideas of the individual consultant, many alternators are connected solidly to the bus, the alternator breaker being non-

(Continued on page 86)

How to Buy Coal and Evaluate Its Quality



By FRED M. REITER

Material Research Engineer

The Dayton Power & Light Company, Dayton, Ohio

LARGE consumers of coal such as electric utilities having no mines of their own or located some distance from mining areas, generally try to obtain their coal from a number of sources. Industries or plants which have their own *captive* mines or which are located near suitable mines with consequent negligible freight cost, have no problem in the selection of their sources of coal. They have a fair assurance of supply, easy transportation, and a low overall cost, factors that worry buyers of coal who face a competitive situation.

These distant buyers, of necessity, become alert to all potential sources of coal suitable to their requirements. In fact large consumers of coal, both utility and industrial, have been designing their equipment for using a greater variety of coals. This enables them to make use of fields not considered previously. In this particular area for example, old boilers had been constructed for District No. 8 high fusion low sulphur coals almost exclusively, and for two-in. nut and slack sizes. New boilers can use practically all sources in the Ohio, Western Pennsylvania, Kentucky, West Virginia and Virginia fields. This has made a big difference in costs, availability, transportation facilities, and provides the feeling of security that accompanies the knowledge that one's eggs are contained in many baskets, each as large and fruitful as the original one basket.

The vast expansion in utility power generating capacity has been a boon to the coal industry. The utilities have picked up much of the loss in the coal market resulting from the conversion of locomotive propulsion from coal to Diesel oil and the loss in the domestic heating sales to gas and oil. As a result a more understanding inter-relationship has developed between the utility and coal industries.

Until recent years the output of coal mines was largely controlled by the domestic market in the sizing of their products. When domestic stoker coal was in demand, carbon sizes of coal were in surplus and available at better prices. When the domestic market dips, two inch nut and slack is pressed for sale in order to absorb the fines and smaller sizes. The fairly constant load of the public utility serves as an ideal outlet for these coals at all times. At the same time the ample stockpiles required for the insurance of production, can serve as an expansion chamber or variable storage silo to take the ups and downs of the coal market.

The utilities are in an advantageous position to benefit from this accordion like capability. They can assist the public as well as the coal industry by gearing their procurement program to take advantage of the variations that occur throughout the year. Many industrial firms which have oil and gas standby equipment have found themselves in strategic positions to benefit by sudden surpluses in different fuels that have needed relief and have been made available at distressed prices.

The critical shortage of transportation facilities, particularly rail hopper cars, adds another factor in favor of broadening the sources of supply among areas fed by different carriers.

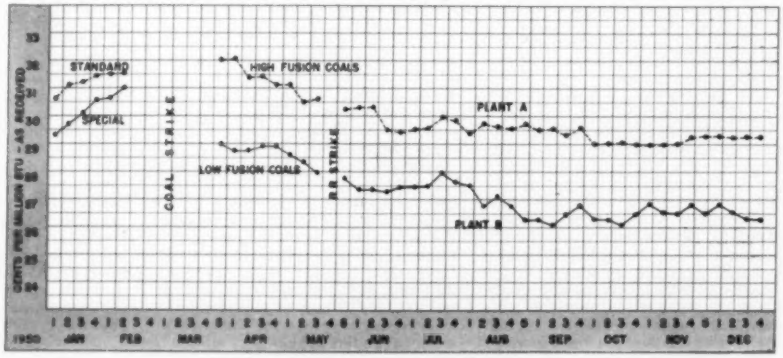


Fig. 1. Weekly weighted average cost of coal. Taken from Weekly Rating Report Year 1950

Certain carriers are known to be closely tied to their basic source of revenue, such as coal, and can be expected to divert fewer facilities to other industries.

A broad use of many coal sources, large and small, new and old, reliable and untried, requires some form of continuous evaluation of their quality as they are received at the power plant. Some type of *watch-dog* method of evaluating and recording selected properties or value of deliveries of each coal not only becomes necessary, but it pays dividends. It not only serves to inform the buyers of the coals of what they are receiving, but if the suppliers are aware that an inspection system is in continuous operation, they will make every effort to avoid careless or accidental shipments of improper coal to this user.

The development of such a system might be compared to that of a publishing house, a city newspaper or a weekly magazine. These organizations continuously secure information from a number of reliable sources that they have developed and established. These sources comprise their own reporters, city police and office representatives, special staff writers, national and international news services, columnists, and myriads of others. Everything is so organized that the flow of information is automatic and practically effortless on the part of the central staff. This staff merely picks out what it wants, puts it together, interprets and evaluates the specific areas of information selected for dissemination.

The well-ordered, large industrial plant or utility similarly has all of its sources of information well established. Its statistical divisions are in continuous operation. Insofar as coal is concerned, information is regularly available from the purchasing, traffic and accounting departments, boiler plant car unloading units, chemical laboratories, power plant test engineers, and so on. These groups all make up their individual reports daily on such items as price, freight charges, numbers of cars of coal received with tons unloaded from each source each day at each plant by car numbers and weights, moisture, ash, sulphur and Btu content, ash softening temperature, and such other information that will guide the fuel engineer or coal buyer in continuously evaluating the coals used.

The specific information desired and the form of the final periodic report on the coals depend, of course, upon the responsible individuals. Much data has been published on this subject. Two most recent articles that have appeared giving current utility viewpoints are: "A Pattern for Sound Utility Fuel Procurement" by Marshall Pease, Jr., and Raymond J. Brandon, Detroit Edison Co, in the Feb 1951 issue of *Utilization*, and "Coal Analyses from the Standpoint of the User", by the writer in the Feb 1951 issue of POWER ENGINEERING.

Such a periodic report must be in a fixed form, concise and clear. The guiding factors should be selected for the best quick overall evaluation of the coals in those properties whose variations are deemed most important. The various operating reports supply fixed and complete information on individual aspects of the coal supply that are obvious and require no comparison or interpretation. Laboratory analysis report sheets provide specific properties of the coal in final form without further calculation. These properties include moisture, ash, sulphur, ash softening temperature, etc., which definitely indicate whether or not the coal meets specifications.

Prices and costs per million Btu are variables subject to competitive conditions. The heat content of the coals, in terms of Btu as received, are variables that may be subject competitive conditions in themselves, not as they may affect the cost per million Btu. Both articles referred to above indicate the variations in heat content since World War II or since that stable period during the '30's. Preparation plants, mine operations, screen sizing, etc., insofar as they affect Btu as received, vary with general economic conditions. The ash and moisture content are automatically obtained in the relationship between the Btu as received and the Btu ash-moisture free.

It is because the quality of coals are so readily varied by mechanical operations that the cost per million Btu becomes an increasingly important criterion in rating the coals of a procurement program. The quality of the coal coming from a given mine can vary, even from shipment to shipment. Our own laboratory records have shown a variation of 1000 Btu as received from the lowest to the highest results in one month on coal from one source which had no washing or preparation plant. This, in-

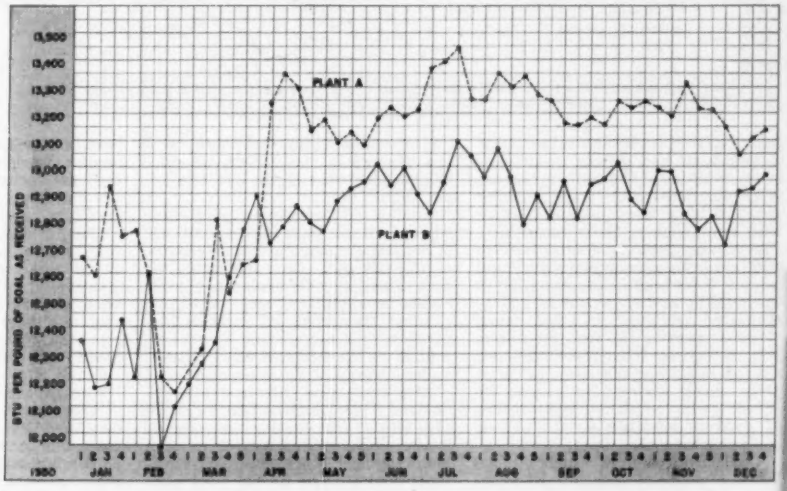
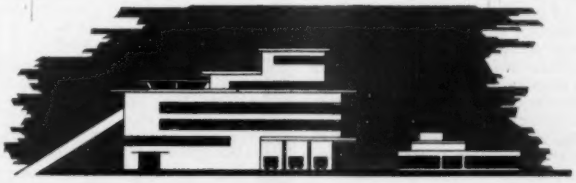


Fig. 2. Weekly average heat value of coal received. Btu per pound as received

Up to 3rd week of August, figures were obtained from boiler plant bunker samples. After 3rd week of August, figures were obtained from Weekly Rating Reports



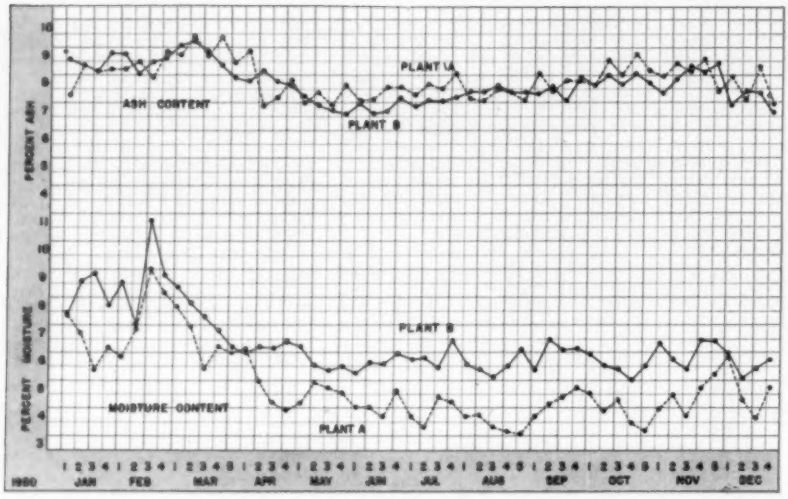


Fig. 3. Record of ash and moisture content of coal used at two power stations. Weekly averages of analyses of samples of coal taken from boiler plant bunkers

deed, has been a very desirable source in which we had general confidence in the abilities of the mine personnel in keeping the quality high, utilizing personal skill and judgment along with hand picking to minimize ash. The vein has been considered uniform and free from excessive moisture and ash but there is probably variation in the quality and structure in widely separated galleries of the mine. Closely watching the cost per million Btu of the coal from this source has proved beneficial not only to us in actual dollar savings, but also to the supplier who has an unbroken record of good dependable service to our company for many years.

Coals from sources which put selected portions of their screened coal through washing and drying processes also show variations that change with conditions and demand. The mechanical control of these processes has greatly improved, particularly where air cleaning and proper mixing of the unwashed fines is practiced. The variations have been minimized. In washed coals the moisture rather than the ash, is the property that produces the variations and problems. In open strip and in newly opened mines higher oxygen content or weathering may produce lowered heat values, as would be indicated by lower ash-moisture free Btu determinations. High sulphur can generally be expected to reduce heat values.

These points are mentioned merely to indicate that there are a number of factors that can increase the cost per million Btu by reducing the as-received heat content. The effects of these factors of ash and moisture on the Btu per pound and on the cost per million Btu are clearly illustrated in the charts shown as Figs. 1, 2 and 3 of this article for Plants "A" and "B" during 1950, a period that had unusual conditions as explained later in the article. These curves show that for purposes of continuous evaluation the properties of ash, moisture, etc., are reflected in the as-received heat value and appear in the overall cost per million Btu.

The power production plant test engineers make their own evaluations of the actual operating characteristics of all coals used. They separately report where specific coals burn well, reduce evaporation, slag tubes, or whether preferred or undesirable. *Practical* characteristics are more critical in the firing of the immense boiler systems of modern power generating equipment than in smaller industrial boiler plants which may supply steam for heating or process work. Such evaluations from the plant engineer, however, are intermittent. They may be special reports requested by the buyer or offered by the test engineer because of unsatisfactory experiences. They could form no part of continuous evaluations of a regular procurement program, but they are certainly most valuable as an additional means of evaluation, usually a very deciding one.

One of my duties is to prepare weekly data on the quality and costs of the various coals received from our many sources. The type of form adopted for the valuation of these coals is illustrated in Tables I and II representing the firms who supply coal to two power stations, "A" and "B". It is a periodic report entitled "Weekly Rating of Coals".

This report follows the patterns described in this article. It is concise, clear, and includes only the essential or fundamental variables. The ultimate criterion used in evaluating the coals is their weighted effect in the percentage of profit or loss incurred in receiving the given quantity of

Table I. Weekly Rating of Coals. (Plant A.)

MATERIAL RESEARCH DEPT. — Weekly Rating of Coals — Week ____ to ____ Month: April

STATION: Plant "A"

Railroad No.	Supplier	Mine	BTU/lb. A-R Free	Cars	Cars Rec'd. this week	Latest BTU/lb. as Received	Diff. BTU over Average	Weighted Effect Percent of Gain	Weighted Effect Percent of Loss	Cents/MM BTU Total Cost	Cents/MM Diff. in Cost Under Average	Weighted Effect Percentage of Cost Profit	Weighted Effect Percentage of Cost Loss
			15,095	2*	3	13,387	+ 262	1.84		28.09	- 2.09	12.38	
1			15,092	"	5	13,473	+ 347	8.52		29.84	- 1.47	12.68	
2			15,226	"	11	13,615	+ 489	52.42		29.09	- 1.08	12.77	
3			14,800	"	10	12,900(1)	- 226		14.72	29.15	- .96	10.17	
4			15,536	"	7	13,958	+ 432	16.85		29.58	- .53	7.43	
5			15,308	"	4	13,418	+ 292	5.73		29.86	- .25	2.80	
6			15,277	"	38	12,916	- 180		22.27	30.01	- .10	1.79	
7			15,095	"	4	13,387	+ 262	3.87		30.10	- .01	.08	
8			15,293	"	9	13,316	+ 190	8.39		30.11	0	0	
9			15,142	"	3	13,262	+ 136	2.00		29.84	+ .13		1.80
10			15,221	"	5	13,223	+ 97	2.38		29.58	+ .39		3.38
11			15,065	"	4	12,806	- 320		6.36	29.99	+ .78		9.96
12			15,150	"	2	12,977	- 149		2.59	31.08	+ .91		5.79
13			15,179	"	8	12,913*	- 213		11.10	33.05	+ .76		23.33
14			14,983	"	11	12,828	- 298		21.36	31.86	+ 1.15		38.87
15			14,908	"	3	12,323	-1005		19.44	32.95	+ 1.94		17.89
16													
17													
18													
19													
20													
21													
22								100.00	100.00			100.00	100.00
	Total				118					30.11			
	Column Average		15,129			13,126				29.96			
	Weighted Average					13,149							

(1) Estimated

* Box cars/cars during this week

each coal, with its as-received Btu per pound, on the overall picture of that plant. This final figure, as indicated before, includes the chemical quality of the coal in Btu as received, its price and freight rate, multipled in its goodness or badness by the total quantity received during the period of the report, one week.

The coals are listed and rated in order of their actual cost per million Btu as received from the lowest to the highest. The figures are calculated from the laboratory report and the purchase price plus freight cost. These unit figures, Column 11 in the reports, tell simply, at a glance, what we pay for the heat in each unit of coal purchased. However the quantity of each coal, as listed by cars in Column 6, will denote how much that coal will affect overall costs during that week.

For example, the cost per million Btu of the 16 coals of Station A (column 11) as units rose from 28.09 to 32.05, a range of about 4 cents. The column average of these 16 coals was 30.11, just about the median of the range. Twenty one cars of coal No. 3 (column 6) were received during the week and unloaded. With but 1.02 cents lower than average cost per million Btu (column 12), this large unloading during this week brought us 42.77 per cent (column 13) of the entire profit for the week. An almost equal number (19) of cars of Coal No. 7 only gave us 3.79 per cent of our profit.

Going to the loss side, Column 14, we note that 3 cars of No. 16 coal produced 17.89 per cent of the gross loss while 3 cars of No. 1 coal yielded us 12.10 per cent of our profit. The 3 cars of No. 16 coal produced about as much loss in total operations for the week as the combined 14 cars of the four coals Nos. 10, 11, 12 and 13. One can see at a glance that receipts should be trimmed from the bottom of the list, working upward as other conditions permit. The 11 cars of No. 15 coal unloaded during any week could well be reduced in order to lower overall costs.

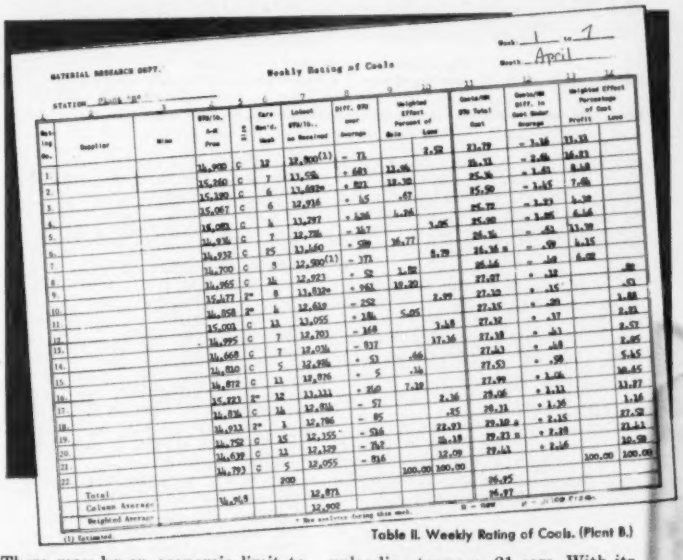
The weighted average of costs per million Btu (column 11) was 29.96 for Plant A. The column average, or straight arithmetical average of the 16 coals, was 30.11. The fact that the weighted average of costs was below the direct column average indicated that more tonnage of lower cost coals was unloaded, a desirable condition. In fact 73 cars of the 8 better than average coals were unloaded compared to 36 of 7 poorer than average coals.

Plant B shows some contrast. Only 89 cars of 9 better than average coals were unloaded compared to 111 cars of 13 costlier than average coals. The weighted average cost of column 11 exceeds the column average. The average cost is not the median of all coals. Coal No. 1 can be procured at 3.16 cents per million Btu below the general average, while Coal No. 16 penalizes us 2.46 cents on each million Btu procured. The picture is obvious.

These costs of heat procured in terms of million Btu are naturally dependent upon the heat values of the individual coals. This property is as important as the price and freight rate. Certainly for the same cost per million Btu it would be advantageous to stress the procurement of the high Btu coals since fewer tons would be required for the same heat procurement. Smaller tonnages in turn reduce handling, grinding, and firing; less ash to dispose of, less moisture to be troubled with, less fly ash, and lower operating costs in general. There may be an economic limit to the lowness in Btu content of a coal with regard to a specific plant regardless of how low costs may get. This may be applicable to some surface mined coals where some oxidation may have taken place reducing not only the as-received Btu per pound, but its combustible or ash-moisture free heat content as well, even with apparently low moisture and ash content. Our plant operating personnel certainly do not like to see coal arrive containing less than 12,500 Btu per pound as received.

For these reasons the weekly report includes a study of heat values together with weighted effects derived from tonnages unloaded, in a manner like that for costs as described above. An examination of the reports exhibited for Plants A and B (Figs. 1 and 2) shows four coals with decidedly unfavorable heat values, No. 16 of Plant A and Nos. 20, 21 and 22 of Plant B, all below the desired minimum of 12,500 Btu, (column 7). Investigation would soon reveal whether the shipper, the miner, or the coal washer at the preparation plant, was responsible. There was no compensating price advantage, for all four coals land at the very bottom of the pile with quite sharp increases in cost per million Btu. Furthermore the losses are further aggravated by sizeable deliveries of tonnages. Coal No. 14 of Plant B does not offend quite so badly.

Plant A had a gross variation in Btu of about 1500 Btu (column 7) with a deviation from its column average of 13,126 of plus 489 to minus 1005. Coal No. 3 again receives honorable mention for 50.42 per cent of the gain in heat purchase above average because of its highest heat value of 13,615 Btu and its high unloading tonnage, 21 cars. With its 489 Btu above average, this coal raised materially the weighted average to 13,169. Similarly, Coal No. 16 can again be given most demerits in the heat supply, as well as in the cost columns.



MATERIAL RESEARCH DEPT. — Weekly Rating of Coals — Week 1 to 7 — Month April

STATION Plant "B"

Reading No.	Supplier	Mine	$/Ton A-M Price	Rank	Cars Rec'd.	Lowest BTU/lb. as Received	Diff. BTU over Average	Weighted Effect Percent of Loss		Cents/MM BTU Total Cost	Cents/MM Diff. in Cost Under Average	Weighted Effect Percentage of Cost Profit	Loss
1			14,930	C	12	12,900(1)	- 73		2.52	31.79	+ 1.16	11.12	
2			15,260	C	7	13,554	+ 581	13.84		28.31	- 2.46	16.23	
3			15,180	C	6	13,682a	+ 821	12.58		27.36	- 1.41	8.18	
4			15,067	C	6	12,916	+ 55	.67		27.50	- 1.45	7.46	
5			14,983	C	4	13,297	+ 436	4.84		28.72	- 1.73	4.38	
6			14,936	C	7	12,786	+ 347		1.05	25.80	- 1.86	6.66	
7			14,932	C	25	13,160	+ 589	16.77		28.16	- .61	11.19	
8			14,700	C	9	12,990(1)	- 371		8.79	26.36 a	- .99	4.15	
9			14,965	C	14	12,923	+ 52	1.82		26.16	- .49	6.02	
10			15,477	P*	8	13,532a	+ 961	10.20		27.07	+ .12		.20
11			14,858	P*	4	12,610	- 252		2.99	27.10	+ .15		.41
12			15,003	C	11	13,055	+ 184	5.05		27.35	+ .20		1.88
13			14,995	C	7	12,701	- 168		1.48	27.32	+ .17		2.83
14			14,668	C	7	12,034	- 837		17.36	27.38	+ .41		2.57
15			14,810	C	5	12,956	+ 53	.66		27.43	+ .18		2.85
16			14,872	C	11	12,876	+ 5	.14		27.53	+ .28		5.45
17			15,223	P*	12	13,111	+ 240	7.32		27.99	+ 1.04		10.45
18			14,834	C	14	12,914	- 57		2.36	28.06	+ 1.11		11.27
19			14,933	P*	1	12,786	- 85		.25	28.31	+ 1.36		1.16
20			14,752	C	15	12,155	- 516		22.93	29.10 a	+ 2.15		27.52
21			14,639	C	11	12,129	- 742		31.18	29.23 a	+ 2.28		23.11
22			14,793	C	5	12,055	- 816		12.09	29.43	+ 2.48		10.58
					200			100.00	100.00			100.00	100.00
	Total					12,871							
	Column Average		14,916			12,900				26.95			
	Weighted Average									26.97			

(1) Estimated — * Box cars/cars during the week. — B = Bale — P = Pickup Price.

Table II. Weekly Rating of Coals. (Plant B.)

Coal sizes are recorded in Column No. 5 in terms of "2" for 2-inch nut

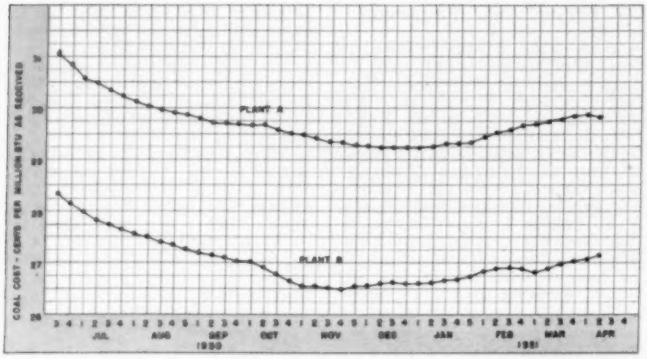


Fig. 4. Movement of quarterly average costs.
Moving average of the 12 weeks (quarter year) ending with the week indicated on the dates given as abscissae below
Based upon weekly weighted average costs per million Btu as received, taken from Weekly Rating Reports

and slack and "C" for carbon sizes, ¾ or ¾ x 0. Carbon sizes would be expected to have a lower heat content as well as a lower price. They should normally have a lower cost per million Btu and would be evaluated accordingly.

Column No. 6 records the number of cars actually unloaded, as shown on plant unloading reports and checked against source shipping records. These figures form the basis for weighting the total heat purchase and cost data for each coal in terms of quantity received.

Each time coals from the bottom of the lists are discontinued or diminished in quantity, the general averages rise. This reduces the relative gain in the good coals and puts the bottom coals in a comparatively lower position. A perpetual contest is thus maintained that gradually lifts the averages to higher levels that result in savings to the Company. It would not be well to reduce the number of suppliers to too few as could be done under the reasoning suggested above. One would ultimately get down to one coal. There must be a constant search for new sources, replacing discarded ones. The maintenance of a larger number of suppliers on the rating lists permits greater procurement flexibility and provides more opportunities for improvement.

For example, Plant A has narrowed in its cost range from plus 1.94 and minus 2.02 from the average of 30.11 cents, a gross range of 3.96 cents per million Btu. Plant B varies from plus 2.46 to minus 3.16, a gross range of 5.62 cents. Plant B has greater room for improvement.

In the heat purchase area of investigation, Plant A varies from plus 489 to minus 1005 Btu, a gross range of 1494 Btu. It has twice the deviation in the minus range as it has on the plus side. The removal of Coal No. 16 would lift the column average from 13,126 to 13,193 and show a plus deviation for Coal No. 3 reduced from 489 to 422; and the new low coal, No. 12, increased from a minus deviation of 320 to 387, a gross variation of 809. This is a more balanced operation. The same reasoning applies to Plant B in lifting its level of standards.

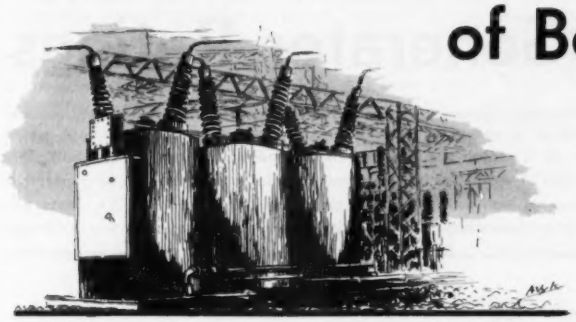
Up to this point a form of weekly report has been discussed as a means of watching the progress of a coal procurement program. It selects certain values of the coals as the important variables for a continuous evaluation of sources. While sufficient in themselves for the purpose designed, these weekly reports do not portray in a really continuous form, the trend or direction. Trends are affected by many conditions beyond the control of the coal buyer in his selection of specific sources. Market conditions, economic factors, wage and price changes, supply and demand, strikes, and many other situations that may enter into the broad picture. Curves or charts lend a more visual distinctness to changes in levels or to the effects of specific factors. Some properties or factors not included directly in the weekly report may merit special consideration.

Figure 1 portrays the weighted average costs per million Btu taken from the weekly reports of the coal unloaded for the year 1950. This chart is of particular significance because of the critical situations that occurred during 1950. It includes the periods of a coal strike and a railroad strike, prior to and during which coal procurement was disrupted. Coals from many untried sources were received. In an effort to keep records of our normal or standard coals separate from temporary sources, figures were divided into two categories of "standard" and "special" coals during January and February, regardless of point of delivery.

(Continued on page 112)

Fig. 5. A good supply of coal

Electrical Features of Bokaro Station



By **HRAND H. LEVONIAN**
Project Engineer, The Kuljian Corporation
Philadelphia, Pa.

CONTINUING the description of the design and construction of Bokaro Station in the October issue, we will now consider the electrical side of the station.

As indicated in the October issue, the initial installation consists of three main generating units, each rated at 50,000 kw. Each generator is rated at 50,000 kw under conditions of 1.7 in hydrogen pressure in the cooling system but by increasing the hydrogen pressure to 15 psi, a rating of 67,735 kva at 0.85 pf can be attained.

Hydrogen cooling equipment, including detraining tank, pump, valves, etc, are located directly under the generator but the hydrogen seal control panel is located on the operating floor with remote indication of temperature, pressure, gas analysis, alarm lights, and horn to indicate faulty conditions.

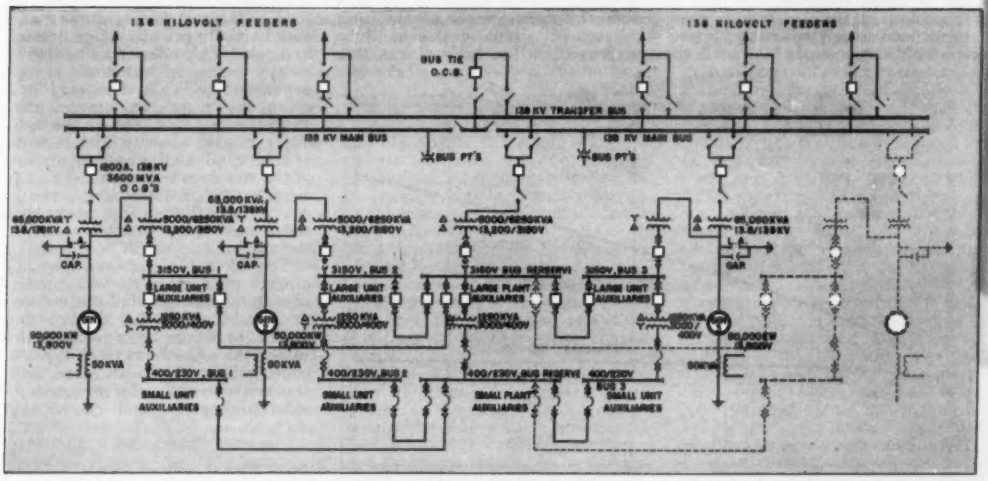
Each generator and its associated equipment constitutes a unit and is independent of the other units in the plant. All connections are kept as short as possible and each machine is connected directly to its 65,000 kva, 13.2/138-kv transformer. Isolated phase metal enclosed bus duct rated at 15 kv and 3000 amp, is run from the generator bushings to the building wall. At the end of this bus run, potheads are provided and cables are run underground in fibre duct to the step-up transformers which are located in the outdoor substation. This cable run consists of four 1500 MCM paper insulated, lead covered cables per phase. Each cable has a neoprene jacket over the lead for protection against electrolysis.

The generator bus is also provided with one additional pothead per phase at the end of the bus run. A cable connection is carried from here to the 5000/6250 kva, 13,200/3150-v station service transformer located just outside the West building wall. This transformer supplies the unit auxiliaries. A bus tap is also carried from the generator bus to a metal enclosed cubicle on the electrical platform below the bus run. This cubicle contains the drawout potential transformers for metering and the voltage regulator, and the lightning arrestors and capacitors for surge protection.

Each generator neutral lead is provided with one bushing current transformer for differential relaying. The leads are then bussed together and connected to ground through a 50 kva, 13,200/220-v distribution transformer. The secondary of this transformer is connected to a 0.63 ohm resistor. A voltage relay is connected across the resistor and sounds an alarm on the duplex switchboard if a ground fault occurs. Since the high reactance ground limits the ground fault current to a very low value, the generator is not taken off the line automatically if a ground fault occurs. This gives the operator time to shift the load to another machine or station.

The high side of each step-up trans-

(*Continued on page 89*)



Single line diagram of the electrical system at Bokaro

Internally Cooled Coils Boost Generator Ratings

New method of generator construction using hollow conductors through which hydrogen is circulated will increase large generator ratings by one half. This new method of ventilation has been tested on large size models and generators with ratings as high as 200,000 kw are to be completed by 1954. These extremely large generating units will be single shaft machines operating at 3600 rpm

By C. M. LAFFOON

Manager, Generating Engineering Dept.
Westinghouse Electric Corporation
East Pittsburgh, Pa.

A RADICALLY new method of cooling large turbine generators greatly increases the ratings in which these high-speed machines can be built. The practical benefits of this development also extend to smaller than maximum-size units because a machine of a given rating can be made smaller than with conventional cooling. The basis of the new ventilation technique is to cool the active conductors internally by making them hollow and blowing hydrogen gas at high velocities through these ducts, thus placing the coolant in intimate contact with the material in which the heat is generated.

The new ventilation system comes at a fortunate time. The maximum practical rating of turbine generators has, over the years, risen steadily. By increasing hydrogen pressure, by improvements in blowers, in metallurgy, and in many construction details it has always been possible to keep pace with the demands for power-generation units. However the need for larger and larger machines is now growing rapidly. With existing labor and materials costs, and the need to keep electric power costs low, it becomes increasingly necessary for electric-utility companies to install the largest generating units that can be effectively utilized by the individual systems and the systems with which they are interconnected. Several utility systems in the United States are of sufficient size and closely integrated by interconnection with other similar systems to justify generating units of 200,000-kw capacity and larger. The cross-compound type of steam turbine generating units can be built for ratings up to 300,000-kw capacity at 3600 rpm, or a combination of 1800 and 3600 rpm. Generators for this type of unit could deliver their kw output ratings at power factors of 0.8 to 0.85 and short-circuit ratios of 0.8 to 0.9 when using hydrogen gas pressures of 30 psig.

Since the tandem-compound turbine generator unit has fewer bearings, higher output efficiency, lower capital and operating costs, and requires less space in the generating plant, there is an economic need to develop it for larger ratings. Although tandem connected generators can also be built for ratings up to 300,000 kw, this type of unit would probably represent little savings or advantages over the cross-compound unit and consequently would not normally be preferred. On the basis of available materials, present design practices, generator characteristics, and conventional construction, single-unit generators can be built at 3600 rpm for maximum rating of 200,000 kw or slightly larger at 0.85 pf, 0.8 scr, and 30 psig hydrogen pressure. The rotors of the units for these large ratings would operate above the first and probably above the second critical speed. At 0.9 pf and 0.5 scr, the maximum generator rating could be increased to 230,000 kw.

Further incremental improvements in the physical, magnetic, electrical, and thermal properties of steel, copper, and insulation, in conjunction with improved ventilation will make possible a further increase in output per unit of generator weight and ultimately result in still larger generator ratings. However, to secure a major increase some radically new feature is needed. During recent years, much attention has been given to possibilities of using other cooling media as a means of overcoming this limitation but as yet none of these schemes has proved practical. The answer to a substantial improvement is believed to lie in internal cooling of rotor and stator windings with high-density hydrogen. This offers possibilities of greatly increasing the amount of copper losses that can be dissipated for a given maximum temperature rise. With the heat flow through the insulation of the windings almost completely eliminated, the temperature of the windings is determined by the temperature of the hydrogen gas in contact with the copper, and the heat transfer coefficient from the copper to the gas.

The curves in Fig. 1 show the rotor ampere conductors per slot obtainable from tests on a full-size stationary model, with the average and maximum copper temperature maintained the same for the two types of construction. The lower curve is for the conventional rotor design with external cooling, and shows that

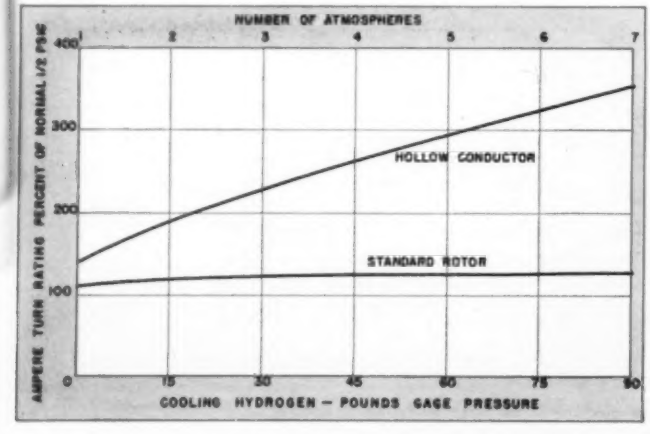


Fig. 1. Effect of hydrogen pressure on ampere-turn rating for hollow conductor and standard rotor

further increase in hydrogen pressure will offer very little increase of rotor ampere conductors. On the other hand, the benefit with hollow conductors is tremendously higher. The increase is extremely high for the higher gas pressures.

The phenomenal increase in ampere conductor output for the inner-cooled rotor winding is obtained by passing large masses of hydrogen gas through internal passages of the conductors at relatively high velocities. It is therefore obvious that the full advantages of inner cooling is basically associated with high hydrogen pressures and requires use of high-pressure blowers to circulate the gas through the internal ducts.

mately twice that for a rotor of a generator of conventional design. Rotating coil models of large size have been built and tested to demonstrate that internal blowers mounted on ends of the rotor can deliver the required mass of hydrogen through the rotor conductors.

These remarks have applied only to rotor cooling. Similar benefit can result from internally cooling the stator coils. The insulation problem is more difficult for stator coils because of the higher voltage involved and the need for creepage paths of greater length over that required for the rotor. With machines in which the cooling can be accomplished by passing the hydrogen gas through the

design, the size factor for the rotor with inner cooling of the conductors is only 62 per cent of that for the conventional rotor. The reduction in stator dimensions is of smaller magnitude since internal cooling of the stator conductors is not used.

Internal cooling of the rotor and stator windings of turbine generators with high density hydrogen is particularly applicable to units for ratings of 90,000 kw and above. The improved cooling makes possible the construction of ratings much larger than now possible with conventional gas cooling. Ratings of 3600-rpm single-unit generators of 250,000 to 275,000 kw now appear possible at power factors and stability characteristics suitable for the large electric utility systems. Under present conditions, the reduction in physical size

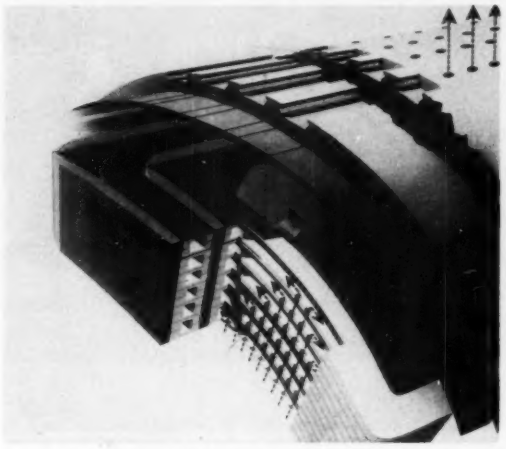


Fig. 2 (Above). Section view of rotor and rotor winding

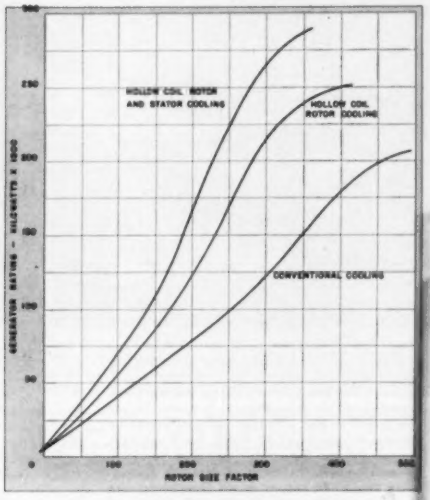


Fig. 3 (Right). Curves showing how internal cooling will affect generator ratings

A section view of a rotor and rotor winding, Fig. 2, shows the path of the hydrogen gas flowing through the rotor conductors for a particular type of construction. The rotor-winding insulation problems are fundamentally the same as for present conventional construction. Creepage paths of the conductors at the central discharge sections are of the same magnitude as for the end turns of present machines. Although the tapered rotor slot may prove to be more difficult to machine, its use results in a much simpler blocking for the straight portion of the rotor coil ends. The end turn blocking is further simplified by elimination of gas flow between coil sides, and the use of a constant cross-section of copper for the circumferential portion of the rotor end turns. In this type of rotor the conductors are necessarily of large cross section and few in number. With the rotor ampere-conductors vastly increased by internal cooling, the field current is large, the field voltage relatively low, and the excitation input approxi-

full length of the coils, the creepage problems are relatively simple and no difficult mechanical and ventilation problems are involved. In the longer machines, in which a central hydrogen discharge is required, the creepage problems are more difficult but do not appear to be unsolvable. At present, the development of the inner-cooled stator coil has not been carried to the same stage as for the rotor, and it therefore may be advisable to apply internal cooling in two steps — the first step for the rotor alone, and the second for the stator.

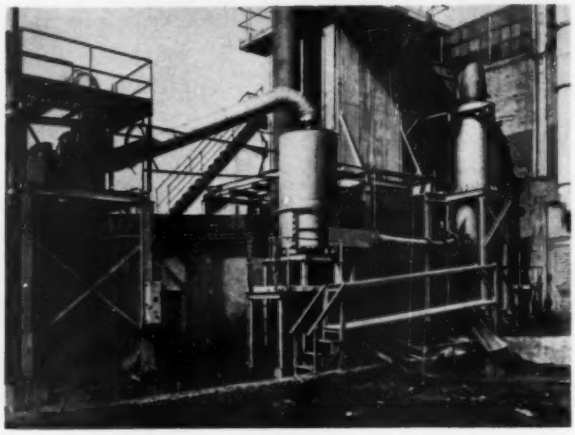
The curves of Fig. 3 show what can be expected of internally-cooled rotor windings and both rotor and stator windings as compared with conventional designs. The kw ratings are based on 0.85 pf, 0.8 scr, and operation at 30 psig hydrogen pressure. From a magnetic standpoint, no changes have been made in flux densities in the stator and rotor portions of the magnetic circuit. In comparing the physical dimensions of a 200,000-kw unit for the two types of

of generating units for a given rating is of paramount importance since it results in the conservation of our nation's two most necessary critical materials — copper and steel. Although the cost savings resulting from the use of less materials are more than offset at the present state of the development by the large development cost required, large capacity turbine generator units of this type, even at present unit costs, should result in lower overall station capital and operating costs without any sacrifice in efficiency performance. The reduced physical size of the rotor element simplifies the forging problem and results in improved mechanical performance and reliability. In addition to the two large machines now being constructed with internally-cooled rotors, a 90,000-kw, 3600-rpm generator, using internal cooling for both stator and rotor windings, is now being designed and is expected to be built and available for testing during the latter part of 1952.

Power Engineering

NEWS REEL

The North of Scotland Hydro-Electric Board has placed a contract with John Brown & Co. Ltd., for design and construction of an experimental wind power plant in the Orkney Islands (off the British North coast) for generation of electricity. This will be first of its kind in Britain. Diameter across the blades will be about 60 ft and it will generate about 100 kw. This contract has been placed in association with the Electrical Research Association, who, at the request of the Government, are investigating the practicability of generating electricity on a large scale from wind.



Electric Storage Battery Co., recently installed this Pease-Anthony Venturi scrubber at its plant in Philadelphia to remove lead dust from exhaust gas produced by a blast furnace in which lead scrap is melted. Hot gases enter the top of the conditioning tower (right) where they are sprayed with water to condense volatile materials. From there, gases enter the Venturi, are accelerated at the throat section (center) and are impacted by multiple jets of low velocity water.

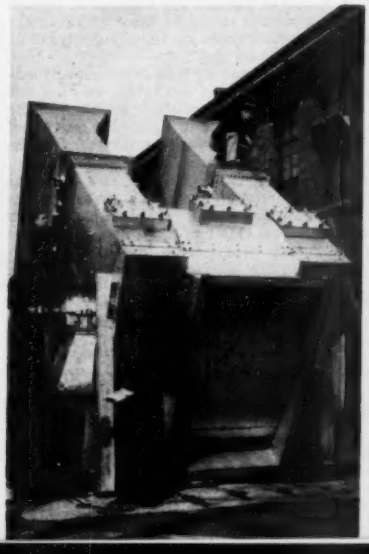
In the centrifugal separator (left) the atomized liquid, containing a high percentage of lead dust originally suspended in the gas, is removed. In this installation, the scrubber is constructed of stainless steel. Fan (extreme top left) draws gases through equipment.

This picture shows one of the reasons why Frank Lloyd Wright, designer of these buildings, is known the world over as a designer of originality, imagination and practicability. This is the project he designed for S. C. Johnson & Co., at Racine, Wisc. The tower is the last of the group to be completed. It houses the research and development facilities. It soars 154 ft into the air on a base only 13 ft across. From this rises a central core, from which each of the 15 floors is cantilevered. The walls are special Corning glass tubing—21 miles of it—laid horizontally, with special synthetic-rubber calking between the rows.

More power for Chicago! Second turbine generator of 150,000 kw capacity goes into service at Commonwealth Edison Co.'s new Ridgeland Station while workmen clean up after 3-yr. job. In center, and in full operation as it was being painted in July, is the 100,000-kw low-pressure element of the new unit. At left is the completed 50,000-kw high-pressure element. At right is Ridgeland's first 150,000-kw unit which began operation last fall. (See POWER ENGINEERING, January 1951 issue.) Two more units, now under construction, will complete the 600,000-kw station. System's expansion program will add 770,000 kw in next four years to bring total system capacity to more than 3,700,000 kw.

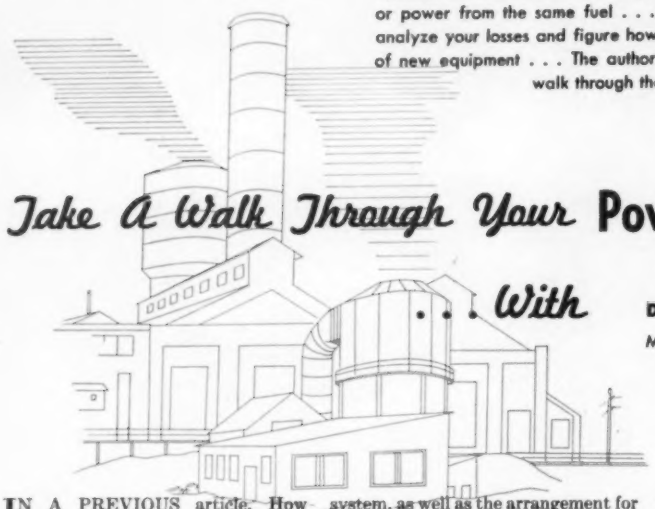
For the first time, surplus water on has been diverted from the head waters of the Colorado River through the Continental Divide to eastern Colorado for irrigation, municipal and power uses, through the 13-mile-long Alva B. Adams Tunnel.

Preliminary test of induced draft fan by research engineers of the Westinghouse Sturtevant Division at Boston, Mass. Destined for installation at Societa Edison, Centrale Di Genova power station in Italy.



Round and Round He Goes!—and when he stops, this inspector will have completed examination of a line-up of synchronous-motor stator frames at General Electric's Large Motor and Generator Department at Schenectady.

Perhaps you must keep your present power plant going until it can be modernized . . . To get the best possible out of it, modern operating methods are the answer . . . They may give you 25 to 50% more steam or power from the same fuel . . . To get management's help in this, analyze your losses and figure how they can be stopped without a lot of new equipment . . . The author suggests items to look for as you walk through the plant with him



Take A Walk Through Your Power Plant . . . With

DAVID MOFFAT MYERS
Myers & Addington, Consulting Engineers

IN A PREVIOUS article, How Management Can Help You Get the Best Out of Your Power Plant, October issue, we pointed out the problem of management in modernizing or replacing an old power plant to get the benefits of modern power developments. If this cannot be done for various reasons, most managements will do *their* best to help you do *your* best with what you have. The answer is modern operating methods, involving little or no capital expense.

First step is to analyze your plant for preventable losses in generation and use of steam and try to stop them. As a beginning, let's walk through your plant and without any instruments, but just by looking around and thinking out loud, let's see what we can find out.

Let's say the plant is 30 years old and located where oil and coal are competitive fuels. First we'll ask about the unit cost of fuel and quantity consumed per year. If this figures $200,000, then for each 10 per cent saving, the owner will have $20,000 a year more for himself.

Is Fuel Purchasing Right?

Although today our choice of fuels is more restricted, we make a note to check into the question of a better purchase, having in mind the existing design of furnace and firing equipment. Also, we must think of the possibility of furnace changes to render the boilers capable of burning either coal or oil interchangeably. This would permit taking advantage of market variations in the relative prices and provide continued operation in the event of coal strikes.

If the present fuel is coal, we will inspect the coal storage and handling system, as well as the arrangement for ash disposal, with a view to determining whether at moderate expense improvements could be made for saving labor cost and improving the general efficiency and cleanliness of the plant at the same time. There is a very wide choice of labor-saving equipment in this field from the simplest aids to the most elaborate and complete systems.

What's the Steam Load?

Entering the boiler house, we naturally observe the pressure and temperature of steam permitted in these old units, and we ask for required hours of operation. We note how many of the boilers are in use and whether the production department is working at its normal level. If there are steam flow meters in working order, we will check the steam output against the number of boilers and their rating, to show very quickly whether there are the right number of boilers on the line.

If proper records of steam or feedwater are not available, we may get preliminary rough figures on boiler loading by daily consumption of fuel per boiler. A quick estimate of probable steam per hour is then made, which, compared to the nominal capacity of the boiler, gives the answer within a reasonable plus or minus. One can often find the key to a big preventable loss in this manner, as later confirmed by further detailed study.

Frequently, in old plants, it is the practice to operate too many boilers, thereby losing the efficiency resulting from proper loading. We therefore may be able to make an improvement here, for we have often been able to shut down one or more of the boilers and thereby increase the efficiency very much indeed.

Inspection of the ash heap will show whether it is rich in unburned combustible. This will indicate the loss through the grates or stokers. If the original coal had, we will say, 10 per cent of ash by chemical analysis, and the refuse discharged to the ash pit contains 50 per cent combustible, this means roughly that the ash pit loss is 10 per cent of all the fuel burned. This would be unreasonably high, and we would look into the cause. If the refuse contains one-third combustible, then the loss of fuel is 5 per cent, whereas 3 per cent would be normally good practice with multiple-retort stokers.

What's Coming Out of the Chimney?

A look at the top of the chimney, if the plant burns oil, should give a pretty good idea of whether there is too much or too little air in the fire for normal efficiency. There should be a slight haze, indicating that the right amount of air is present to burn the oil. If there is no haze, there may be a very large excess of air, resulting in waste.

In the case of coal burning, rather similar rules apply, so that a clear stack may mean much more waste than one showing a slight haze. If black smoke appears, however, we will find out why. If we observe the condition of the fire in the coal-burning plant, especially if the stack is clear, we are likely to find holes in the fire bed, due to clinker or unequal distribution of the fuel on the grates or leaky boiler settings or too thin a fire.

As much air can leak through a brick setting as that which passes through the grate or stoker to support

the combustion. Such air leakage robs the boiler of heat. The portion of the air supply which goes directly to the fire may also be far beyond requirements. This means a very substantial loss; excess air beyond the needs of combustion is the most prevalent cause of waste in the burning of fuel. The proportion of air to fuel determines the chimney loss. Excessive air supply may make this loss greater than 30 per cent of the fuel burned. Its proper correction may reduce this loss to about 10 per cent.

Stop Setting Leaks

The leakage through the brick settings is very readily and inexpensively correctible by applying a plastic air-tight coating, which is made for the purpose. This is done after cementing any large cracks which may be evident or discovered by a simple smoke test.

This simple procedure is one of the most productive and cheapest ways to save fuel in an old boiler plant. Of course, if any major repairs to the brick settings are called for, they should be made first before the air-tight coating is applied.

One way to keep tabs on the air-fuel ratio is by means of an automatic CO_2 recorder. The proper CO_2 (which is the inverse expression of free oxygen) to maintain depends upon the fuel analysis and the furnace design and boiler rating. Depending on these factors, the CO_2 should be from 12 per cent to 16 per cent with bituminous coal and up to 13.5 per cent with fuel oil.

Another way, and an excellent one, is the use of a steam-flow-air-flow meter on each boiler. By so regulating the fire as to keep the two pens together, the air flow will be proportional to the steam flow. The meter must first be set with an Orsat analyzer so that the CO_2 will be right when the two pens are together.

We shall next ask what efficiency or what evaporation per pound of coal or per gallon of oil is being obtained. If this information is not available, we can put it down for a fact that here is a real chance to cut down the cost of fuel in this plant. When you don't know what results you are getting, you can safely bet they are not good. Neither a business nor a boiler can be run efficiently without suitable records.

Incidentally, the appearance of the fires is a good indication of the combustion efficiency to anyone who has lived with this problem. The condition of the fire bed and the character of the flame and its distribution and volume tell their own story. With sufficient practice, one can estimate closely the percentage of CO_2 and excess air in the combustion gases. Therefore we look carefully at the fires.

The top efficiency of water-tube boilers and stokers of the general size and type that were used thirty years ago was about 75 per cent at best point of rating. In their old age, we don't expect that much today, but we do know such plants can be run at 70 per cent or better if kept clean, in good repair, and intelligently operated.

On the other hand, unless they are kept in good repair and properly run, their efficiency may be down to 45, 50, or 60 per cent. Hence we have here a substantial waste that can generally be corrected at relatively small cost.

This means that all necessary repairs must first be made, the heating surfaces of the boiler must be cleaned and kept clean inside and out, the draft and damper controls must work properly and be ample, and a fuel adapted to the design of furnace must be supplied. There must be provided suitable and efficient control of combustion and steam output and proper recording instruments. Modern combustion controls with automatic proportioning of air to fuel can be applied to these plants with enough saving to pay off the installation very quickly in most cases.

Are Things Clean?

In connection with external and internal cleanliness, we will check for automatic soot blowers, and for the method of conditioning the boiler feed water make-up supply, also what percentage of make-up is required and why. An expert control system of feedwater conditioning is a "must" for safety, long life, and efficiency. Soot on the outside and scale on the inside of heating surfaces can account for preventable losses up to 15 per cent or more.

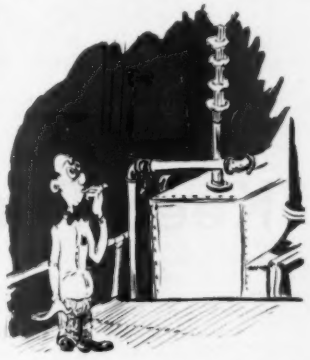
We will look over the boiler house generally to see how good the housekeeping is. Even an old plant should

be clean, kept in workmanlike condition, with no uninsulated hot piping, or steam or water leaks. Here we shall put our hand upon the blow-off main, which will indicate whether the blow-down valves are leaking away good hot water made at the cost of added consumption of fuel.

A temperature recorder in the blow-off main (except in the case of automatic continuous blow-down) not only checks occurrence of leaky valves, but also serves to time and record blow-down intervals.

How's the Feedwater?

Let's have a look now at the feedwater heater, which we hope will be an open type supplied with exhaust steam for bringing the feedwater up to a temperature of at least 212 F. It is probable that the exhaust from



the steam-driven feed pumps will supply this feedwater heater together with other exhaust steam that may be available. We will note the back pressure on this exhaust steam line and compare the feedwater temperature to what it should be at this pressure.

Frequently feedwater heaters get out of order, and the overflow runs continuously and unobserved, which is most undesirable and costly. Are the hot returns free from oil? If not, where does it come from and what measures must be taken to prevent its entering and damaging the boilers?

Before entering the plant, we have looked for plumes of escaping steam above the roofs as subjects of inquiry. If the one from the vent of the feedwater heater is gentle and reasonable, it will pass muster. On the other hand, I have found vents from hot wells or relief valves discharging high into the air, wasting enough steam to heat a good-sized factory building in coldest weather. The cause calls for investigation, and will be later discussed.

The feedwater heater of 30 years ago would be without deaerating equipment to remove oxygen from the water entering the boilers. Possibly it will not be necessary, with proper venting, to recommend the addition of a deaerator, but in any event we will look into this and check with the analysis of feedwater and possible pitting of the metal on the inside of the boiler.

Dependent upon various conditions, it may be found that the feed pumps, and perhaps also steam and air compressors supplying exhaust to

(Continued on page 114)

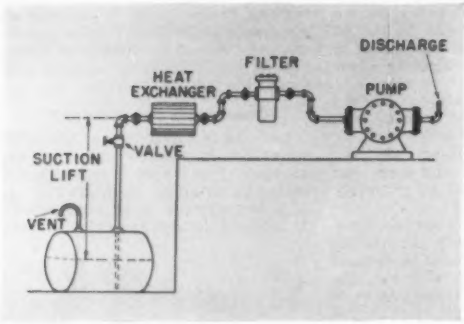


Fig. 1. This pump inlet system tends to cavitation

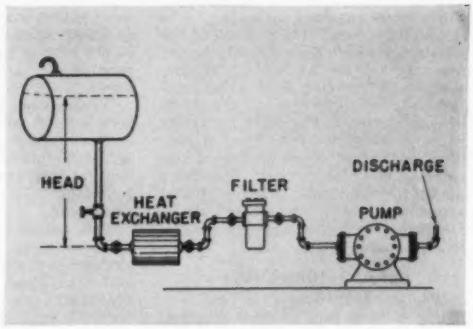


Fig. 2. This pump inlet system minimizes cavitation

Keep Pump Cavitation Down

By BRUCE R. WALSH

Gulf Research and Development Co., Pittsburgh, Pa.

Here are things you can do to control the factors producing cavitation in your pumps, especially your reciprocating and rotary pumps . . . Problems not too hard . . . Incomplete filling of pump, leading cause of cavitation, caused by incorrect suction conditions . . . Some factors must be controlled by pump designer in original design of pump . . . Operator has no control over these * . . . But you do have control over the pump inlet system; you can eliminate air leaks, you can prevent screen or filter clogging—all contribute to cavitation . . . Here Mr. Walsh tells how to go about it

ANY PUMP, NO MATTER HOW CAREFULLY DESIGNED, may operate in a cavitating condition (incomplete filling of the pump by the liquid handled) if the various related factors are not properly considered.

The approach to the problem is not difficult when it is considered that the maximum suction any pump can possibly create is that obtained when the pressure within the pumping members is reduced to 0 psi abs. With the exception of precision-made vacuum pumps having special sealing arrangements, the ordinary reciprocating or rotary positive displacement pump is not capable of reducing the absolute pressure in the pumping members below about 0.5 psi. This means that at sea level, with an atmospheric pressure of 14.7 psi acting on the liquid in a supply tank level with the pump, only about 14.2 psi is useful for forcing the full flow liquid capacity of the pump from the supply source into the expanding spaces within the pump (teeth, vanes or cylinders).

This explanation accounts for the fact that none of these pumps can handle a suction lift greater than a distance equivalent to a 14.2 psi head of the liquid (31 ft for water and 36 ft for oil). Pump cavitation will occur, therefore, if the total restriction to flow in the inlet system between the supply and the interior of the pump is such that the total pressure drop for the pump delivery capacity is in excess of 14.7 psi. It may be realized, therefore, that even if a pump had no resistance to flow between its inlet flange and the interior of its pumping members, it will cavitate if too much resistance to flow is installed in the line leading to the pump or if the suction lift is too high.

For this reason, careful attention must be given to the size and type of heaters, filters, valves and fittings, as well as the size of pipe and amount of suction lift involved in the inlet system. Inlet lines should also be as short as possible.

Since all types of rotary or reciprocating pumps have some inherent internal resistance to flow, depending upon the inlet design, it is advisable to conduct a simple test on the pump to ascertain its losses in order to determine the amount of additional resistance it will tolerate in the inlet line. In such a test the pump is operated at rated speed and discharge pressure using a liquid with negligible vapor pressure such as lubricating oil having a viscosity comparable with that of the liquid to be handled. A vacuum gage is connected at the pump inlet flange and flow measurements are taken over a range of vacuum gage readings adjusted by means of a throttle valve installed in the inlet line to the pump. The reading of vacuum at the point where full flow is no longer obtained subtracted from the barometric pressure (14.7 psi at sea level) is a direct reading of the inlet loss of the pump. It is advisable that this test be started at a high value of vacuum in order to minimize the effect of dissolved air usually present in lubricating oil. Since vacuum gages usually read pressure in inches of mercury (full scale = 30 in. hg = 14.7 psi), this reading should be converted to pressure in psi (2.035 in. hg = 1 psi). The vacuum reading in itself is a direct measurement of the maximum resistance at full flow conditions which cannot be exceeded in the inlet line to the pump.

Figure 1 shows an inlet system conducive to pump cavitation. In this case, assumed pressure drops are listed and totalized in Column I of the table for the rated liquid capacity of the pump.

Since the preceding total is in excess of 14.7 psi, pump cavitation will occur and something must be done to reduce this total pressure to a value less than 14.7 psi for full flow. Since the pump loss and the lift cannot be

* A detailed discussion of the causes of cavitation in reciprocating and rotary pumps and the things the pump designer can do to minimize it, when designing the pump and the results of model test were given in a paper, Cavitation in Reciprocating and Rotary Pumps, by R. J. S. Piggott, presented before the 6th National Conference on Industrial Hydraulics, Chicago, June 1950. Mr. Piggott is Director, Engineering Division, Gulf Research and Development Co. and has just been nominated president of ASME for 1951–1952.

changed, it is necessary to increase the pipe size, reduce the number of fittings, increase the filter size and install a heater arrangement having reduced friction loss.

Where the oil supply is elevated above the pump level, as shown in Fig. 2, it is possible to experience pump cavitation, if the net resistance to full flow remains greater than 14.7 psi. This is shown in Column II of the table.

Reducing the inlet system pressure loss to a value below 14.7 psi is advisable because there are usually other factors to be considered. These will be discussed later. It is recommended that this loss should not be allowed to exceed 10.5 psi which, since it includes the pump losses, would mean about 5.5 psi for the piping up to the pump inlet.

A pipe size should be selected such that the velocity of flow will be about 3 fps; 5 fps should be considered maximum. As a further consideration in the reduction of friction loss, the viscosity of the liquid handled must not be overlooked. If practical, viscous liquids should be heated to reduce the viscosity as much as possible, consistent with satisfactory pump efficiency.

The more viscous the liquid, the greater should be the size of piping and equipment used. A complete analysis of the relation of liquid viscosity to the friction losses in piping, fittings, bends and equipment such as heaters, valves and filters is beyond the scope of this article.

Full liquid delivery from the pump cannot be expected if an air leak exists anywhere in the inlet system. This is because the pump, being of fixed volume, will deliver a reduced volume of liquid proportional to the volume of air pumped. Therefore, it is essential that all fittings and piping be provided with clean, full threads and that all gaskets be airtight. Pipe compound should be used on threaded connections and the number of connections held to a minimum. Flange connections may be preferred to unions. Also the use of tubing and welded or brazed connections should also be considered.

Another place where air may leak into the inlet system is at the pump shaft seal. In some applications it has been found necessary to provide a positive hydraulic pressure on the seal in order to eliminate the admission of air at this point.

Where a value is used in the inlet line, it should be installed in a manner such that a head of oil is applied to the valve stem. This will prevent the admission of air through the valve packing. If a globe valve is used, it should be installed as indicated in Fig. 3.

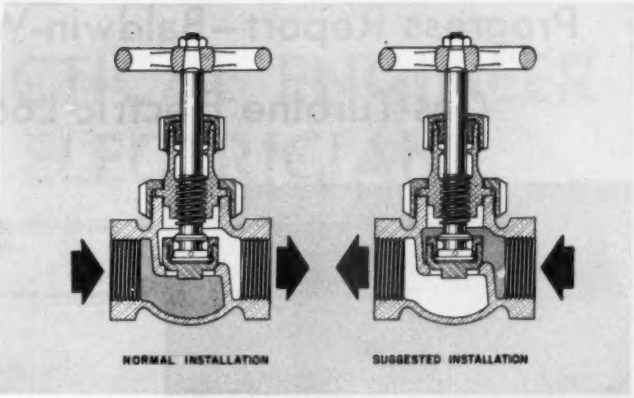


Fig. 3. Two ways of installing globe valves. Normal installation is shown at the left. The installation at the right is a suggested method to keep a head of oil applied to the valve stem

Not only must air leaks in the pump inlet system be avoided, but the amount of entrained air should also be held to a minimum. In any system where the liquid is recirculated, air entrainment may be decreased if the entering stream is introduced in a manner to avoid splash and turbulence of the supply liquid. With a smooth submerged entry of the return stream into the body of liquid in the tank, air is decreased and in some cases it may be desirable to install baffles between the incoming and outgoing liquid to aid any air bubbles in rising to the surface. Time of dwell of liquid in the supply tank is important to permit escape of entrained air. Tests on cylindrical storage tanks using 180 SSU viscosity oil have shown that the time of dwell should not be less than two minutes for satisfactory air separation. This time should be increased for more viscous liquids. The distance the air bubbles travel to reach a free surface should also be kept to a minimum

The volume of air in the supply liquid is not truly indicative of the volume this air will occupy within the pump. A small volume of air entering the inlet pipe will expand as it moves along toward the pump and will occupy a volume within the pump depending on the pressure ratio existing between the pressure at the liquid source and the pump internal pressure. Assuming a combined inlet pipe and pump loss of 10.5 psi and 14.7 psi pressure existing at the liquid supply (with no liquid head), a unit volume of air entering the system will occupy three and one-half times this volume within the pump, thus: 14.7 ÷ (14.7 − 10.5) = 3.5.

Many liquids contain air in solution. This air will dissolve by weight in proportion to absolute pressure, the dissolved volume at any saturation pressure being a constant. For example, air will dissolve in water 0.02 cu ft per cu ft, 0.09 cu ft per cu ft in oil and 0.18 cu ft per cu ft in gasoline. Since this air will come out of solution when the pressure is reduced, as occurs in the inlet system to the pump, it will appear in the form of entrained bubbles which will still further reduce the liquid delivery.

This dissolved air can be troublesome in industrial burner installations where fuel, especially residual oil, is pumped from underground storage tanks if the losses in the inlet line are too great. In order to prevent flame failure resulting from interruptions to fuel flow by the presence of air, a residual fuel should be heated in the underground tank to a viscosity of about 150 SSU (with due regard to flash point) and the inlet pipe should be as large as possible. Where more than one burner is involved, separate lines should be run to each unit from the supply tank.

In cases where a pump is operating on the verge of cavitation, it may be thrown into a cavitating condition by the partial clogging of a filter or screen. In such instances it would be well to install a twin strainer to permit frequent cleaning without interruption of flow or a self-cleaning power driven filter. The area of the openings in the strainers should be slightly smaller than the smallest

(Continued on page 118)

	Column I	Column II
Suction lift	3.0 psi	−3.0 psi
Pipe friction	2.0 psi	2.0 psi
Valve loss	2.5 psi	2.5 psi
Fitting and bend losses	4.0 psi	4.0 psi
Pressure drop in heater	2.5 psi	2.5 psi
Pressure drop in clean filter	2.0 psi	2.0 psi
Pump inlet loss	5.0 psi	5.0 psi
Total friction loss	21.0 psi	15.0 psi

Progress Report—Baldwin-Westinghouse Gas-Turbine Electric Locomotive

By T. J. PUTZ

Manager, Locomotive and Gas Turbine Engineering Division
Westinghouse Electric Corp.

Fig. 1. Baldwin-Westinghouse gas-turbine locomotive under construction, with one turbine unit in place

THE BALDWIN-WESTINGHOUSE 4000-hp gas-turbine locomotive, described at last year's meeting of the Midwest Power Conference, was completed early in 1950. It has been operated in road service several months, tested with various grades of fuel oil at the East Pittsburgh Works and is currently in operation on the Pittsburgh and Lake Erie Railroad burning Bunker C fuel. General operation of the locomotive has been good and the test results well within predicted expectations.

Construction Details

Figure 1 shows the locomotive during construction. You see one of the two gas turbine units mounted in the cab. In the foreground are the electric generators, which are connected through a gear to the straight-through gas-turbine unit. The exhaust from this gas turbine unit passes through a drum and water tube type waste heat boiler, which produces steam for train heating, and then passes out the stack cut in the roof section of the locomotive.

Two large openings in the roof sections are the inlet and exhaust connections for the gas turbine unit. The location of these air and gas connections has proved satisfactory and no difficulty with fouling or erosion of the compressor has been experienced.

Figure 2 shows the completed locomotive. It is arranged for single end operation and has four two-axle swivel trucks with all axles motorized. This unconventional arrangement of running gear makes possible a large equivalent centerpin spacing having good tracking stability at high speeds. In road operation the riding qualities of the locomotive have been found to be excellent. Speed limitations on the road on which it has operated have not allowed testing this running gear at the maximum speed of 100 miles per hour for which it was designed, but there is every indication that its operation should be entirely satisfactory.

The locomotive was completed in April, 1950, and placed in road operation in May burning distillate fuel oil. The initial operation was on the Union Railroad in pusher service. This allowed setting controls and checking performance of all apparatus. Following approximately one month's operation in this type service, the locomotive was moved to the Bessemer and Lake Erie Railroad where it was used in ore hauling service. It operated between Greenville and N. Bessemer making one round trip per day and was assigned loads up to 2200 trailing tons.

Operation Experiences

Operation of the locomotive was continued on the Bessemer and Lake Erie until a turbine blade failure occurred on one of the gas turbine units. Detailed examination of the failed blades showed that the failure was caused by operation at excessively high temperature. In the initial operation on the Union Railroad, this turbine had been subjected to a gas inlet temperature of 1750 F for approximately 10 minutes. This occurred when the locomotive was operated at maximum power pushing

(*Continued on page 113*)

Fig. 2. Completed Baldwin-Westinghouse gas-turbine locomotive

The PRACTICAL ENGINEER *and* ELECTRICIAN

ANDREW W. KRAMER, EDITOR

ORIGINALITY

WHAT is originality, anyway? There are just as many definitions of it as there are definers. And no two of the definitions are alike and very few of them really satisfy.

It's all right to say that originality is inventiveness, the power to originate, according to the dictionary.

To originate is to be the producing cause of, to create. And so on and so on.

None of that tells you what you have to DO to be original. And that's the important thing. Can you be original by just trying to be so? Our observation is that you can't. Originality often results when you're trying to meet some demand, without giving a thought to being original but concerned only with using the most direct, simple, inexpensive, effective method you can devise.

These reflections overcame us as we were making up the pages that follow in the Practical Engineer. Some of the ideas seemed quite original, yet they were not entirely new. And then we suddenly remembered that somebody has given a definition of originality in terms of what a man of originality DOES, rather than what he is. That definition is: "If you copy from one book, that's stealing; if you copy from ten books, that's research; if you copy from 20 books and then add something all your own, not found in any of them—that's originality." Fight with that definition all you wish—but try to better it.

That means the original man uses all the best of previous knowledge that he can apply to his problem. But he either puts it together in a new way, all his own, or adds some little detail, usually already in use for some other purpose, that gives the whole thing a new twist. Then people say, "That's original!"

Well, from that standpoint much of the work the practical engineer does is original. He uses the good ideas of others but in adapting them to his own particular needs he often displays unique originality.

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Level Your Drill
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"Husher" for Oil Burners Pacifies Neighbors
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A Section of POWER ENGINEERING Devoted to
PLANT OPERATION AND MAINTENANCE
Technical Publishing Company
110 South Dearborn Street, Chicago 3, Illinois

Give Your Motors a Break

Don't neglect them . . . Look at them once in a while . . . Clean them, check the bearings, the slip rings or commutators, and other moving parts for wear . . . Measure clearances and operating temperatures . . . Do these regularly and your motors will give you long, trouble-free service

By EDWARD DAUGHTRY

Mutual Boiler and Machinery Insurance Co.

ELECTRIC MOTORS, when properly cared for, are extremely reliable machines. Like any other machine, however, they require a minimum of care, indeed, consistent performance of motors is a function of the maintenance they receive. Where motors operate under full load conditions, maintenance should be of the best. A weekly check should include inspection of dust and dirt on the windings, bearing oil, air gap, commutator, slip rings, brushes, and internal parts. Such over-all weekly inspection pays off in continued trouble-free operation. The lack of it, on the other hand, results in troubles such as illustrated in the accompanying photographs. These photographs are presented here by courtesy of Mutual Boiler and Machinery Insurance Co. of Boston.

Rotor Drop

Because of the necessity of very close tolerances between rotor and stator it is imperative that motor bearings be accurately fitted, and that these tolerances be checked frequently and properly maintained. Undue wear permits the rotor to drop from its concentric position in the motor frame, this in turn creates an unbalance and after the wear becomes accentuated the rotor will strike and abrase stationary parts, damaging the stator parts which are in proximity to the fast turning rotor. Abrasions of this description have caused innumerable motor failures which in most cases could have been averted by inspection.

A primary cause of failure, where rotor drop is concerned, is lack of lubrication to the bearings with consequent excessive bearing wear or oil leakage which allows all the oil to run out of the bearing. (See Fig. 1.)

It can readily be visualized from these pictures how a rotor drop can occur through worn bearings and indifferent attention.

Dust, Dirt and Oil

The absolute lack of any maintenance program is illustrated in Fig. 1, which shows a 25 hp induction motor installed in a lumber mill. This motor "gave up the ghost" after being subjected to operational conditions which were appalling. This motor received no attention whatever, except for an occasional squirt of oil to the babbited sleeve type bearings, which allowed oil to leak out and mix with the incrustation already accumulated on the internal surfaces of the motor. The bearings were a loose fit, so that the oil could readily escape from the bearing housing. The severe use of the motor, the centrifugal attraction of more dust and dirt, the use of more oil, and consequent oil impregnation of the internal surfaces of the motor cumulatively created an impossible operational condition. It finally reached a point where all available internal space was filled with an oily mass which gradually hardened from motor heat, restricted ventilation and inevitably caused the failure of the motor.

The damage sustained was extensive, involving a complete stator and rotor rewind, but as a further loss there was not a replacement motor available in stock and the driven machine had to be shut down for a considerable period until repairs could be effected.

Figure 2 illustrates another case of poor maintenance. Here we have a 75 hp motor driving equipment used in the manufacture of refractory bricks under constant heavy load. It was never looked at over a long period. As can be seen, the heavy deposit of dirt, even on the entire stator surfaces, clearly shows that only passive maintenance was given this electrical equipment. With just a minimum of attention this motor would have given years of satisfactory service at little cost, but it was allowed to run to destruction through neglect and had to be completely rehabilitated. The minimum cost of repair on this motor would be $1500.00.

Sand and Bearings

Figure 3 shows a 100 hp motor used in a sand pit, driving a mechanical screen. Here we have a different condition: namely, the lack of attention to roller type bearings. These bearings were run continuously, exposed to the abrasive action of sand. If the bearing cap had been removed just once for inspection the motor would have had to be serviced. After

Fig. 1. A case of rotor drop caused by lack of bearing lubrication

Fig. 2. A 25-hp induction motor in a lumber mill which gave up the ghost under adverse operating conditions

observing a condition of this nature, any mechanic worthy of the title would naturally take steps to forestall a failure. He would resolve to make routine dismantled inspections, and schedule a weekly check on all equipment so exposed. After once observing a dangerous operating situation with expensive equipment subject to hazardous conditions, a good maintenance mechanic would not feel justified in allowing good machinery to waste away.

Like Concrete

Figure 4 shows a 150 hp motor from a paper mill. That deposit on the stator windings is a mixture of pulp, clay, oil and dirt. It looks like concrete and it is just as hard. This motor suffered a general over-all breakdown of insulation and had to have a complete stator rewind and new bearings. This expense could have been averted by periodic cleaning and checking.

Lubrication

Ball and roller bearings are very extensively used in industry, even in the larger sizes of motors, and give very satisfactory service. These bearings are fabricated for use with either grease or oil as a lubricant, although grease is in general use for this type of bearing.

The reasons for the use of grease as a lubricant are varied but its retentive qualities and the ease of application are the most important. Its solidity as compared to oil, and consequent minimizing of the ever potential contamination of motor windings with an injurious film of lubricant is apparent. Soaking of electrical conductor surfaces with oil or grease increases the fire potential as a flashover or arc from an insulation breakdown may ignite the oil soaked insulation on motor windings and if combustible materials are in proximity to the affected motor, a serious fire could be started.

If a good progressive maintenance program is followed, including the aforementioned items, motor failures will be reduced.

Annual Dismantled Inspection

A further requirement to good motor maintenance is an annual dismantled inspection. By this is meant the complete dismemberment of the machine to permit all parts of a motor to be inspected. The bearings should be inspected for wear and the bearing housing should be observed for breaks, cracks or flaws. The shaft should be examined for incipient cracks. Oil or grease apertures and reservoirs should be flushed clean to remove the year's accumulation of sediment. Stator and rotor surfaces should be readily examined for insulation breaks or flaws.

When a program of this kind is adhered to greater confidence can be placed in your motors for dependable performance.

A NEW METHOD of cooling transformers has been developed by Westinghouse. This development, which may reduce the weight of transformers by one third and step up the power-handling ability makes use of evaporative cooling. Nozzles spray liquid fluoro-carbon on the hot core and coils.

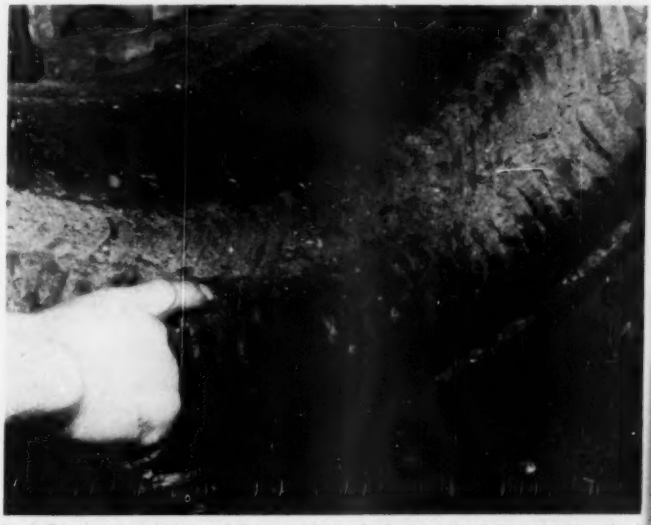


Fig. 5. That deposit on the stator windings is a mixture of pulp, clay, oil and dirt, and is just as hard as concrete

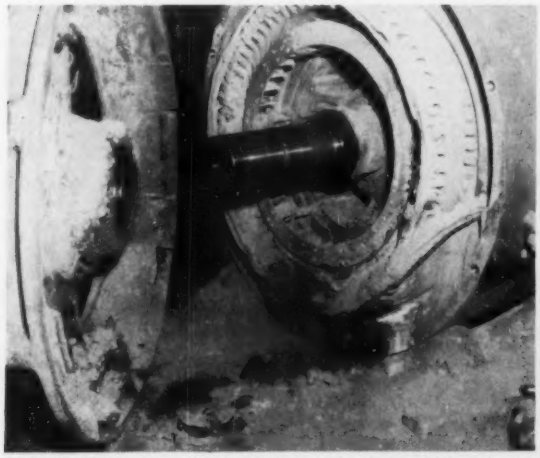


Fig. 3. This 75-hp motor used in the manufacture of refractory bricks and under constant heavy load was run to destruction and had to be completely rehabilitated

Fig. 4. The abrasive action of sand on the bearings stopped this motor which was used to drive a mechanical screen in a sand pit

Photo Armstrong Machine Works

Fig. 1. Inverted bucket trap open for inspection

Steam Trap Care Pays Dividends

By CARL THOMAS

THE IMPORTANCE of efficient operation of steam traps cannot be over-emphasized, since their failure to function correctly may directly affect production and cause considerable other monetary loss.

If a trap fails to discharge condensate rapidly enough, steam will be prevented from reaching all parts of the heating surfaces. Likewise, if the trap is slow in removing entrapped air the steam will be sluggish in entering the apparatus. In addition, the air within the steam-using equipment will mix with the steam and reduce its temperature.

Any one of these faults can result in substantial increases in heating time or reduction in available heat, thus slowing down production. Where all the faults are present the situation can be quite serious, from an economic standpoint.

Where a trap fails to close tightly, or for any other reason permits live steam to pass through and be wasted, the direct monetary losses can be relatively staggering, especially if the defect is permitted to continue for a long period of time. As an example, a ¾-in. trap permitting steam at 100 lb pressure to pass unrestricted through its valve orifice can waste more than $1200 in a year.

While steam traps are made in a variety of types they all require certain general maintenance procedures, and these, together with others specifically applying to particular types, will now be discussed.

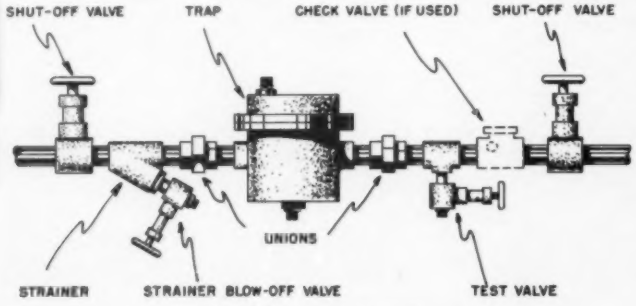


Fig. 2. Typical steam trap connections

Keeping Records

In order to insure adequate maintenance of every trap it is important that suitable records of trap maintenance be kept. These need not be elaborate. A card file having a separate card for each trap is handy. Each card should be numbered, and a metal tag bearing the same number should be attached to the trap with wire. This number should be the trap location number, not the individual trap number, which latter number should be stamped or stenciled on each trap when purchased.

Whenever a trap is removed from service and replaced with a new or reconditioned trap, the location number tag should be attached to the replacement trap.

Each trap record card should bear the date on which the trap was originally installed, as well as the dates of all subsequent tests, repairs and replacements.

A separate section of the file, or a separate file, should be kept for the cards relating to each maintenance period. For instance, traps in severe service should be tested every three months, or oftener if tests show this necessary. Traps in ordinary service should be tested at 6-month intervals, and heating traps should be tested once a year, preferably during the period when the heating system is not being used. By keeping the cards separated in groups this way it will simplify the work of handling maintenance on each group of traps.

Service and Repair

While it is usually possible to work on a trap while it is in the line, time will generally be saved and better work insured if the trap can be readily removed from the line and taken to the shop for servicing or repairs. This is especially true where traps are located in places difficult of access, or where surroundings may present a hazard or otherwise render servicing difficult.

Where a suitable form of standardized hookup is adopted, similar to that shown in Fig. 1, the trap may be readily removed and replaced by simply opening two unions. An additional advantage of such an arrangement, where all fittings and piping are duplicated in size and length for the same size and type of trap, consists in the complete interchangeability of trap units. Thus where continuity of service is important, a trap unit may be removed at any time for repairs or periodic servicing and immediately replaced with a spare unit that has been previously serviced. In many instances this eliminates the need for a trap bypass.

To help prevent dirt, scale, rust, chips, etc. reaching the valve parts of the trap, it is advisable to install a strainer ahead of the trap.

A check valve should also be installed between the trap and the return line, where the pressure in the return line would force condensate back through the trap and flood an idle piece of steam-consuming equipment.

Most traps are equipped with a test plug which may be removed to observe the operation of the trap. However, for greater convenience and safety, a small test valve may be installed on the trap test connection or in the discharge line from the trap as shown in Fig. 2. For safety, it is well to plug the test valve outlet when not in use.

Figure 3 shows a standardized hookup for a trap used in conjunction with a bypass. To prevent unauthorized use of the bypass and consequent waste of steam, it is advisable to remove the valve wheel and issue wheels only to the members of the engineering or trap-servicing crews.

As shown in Fig. 3, a dirt pocket may be installed on bottom inlet

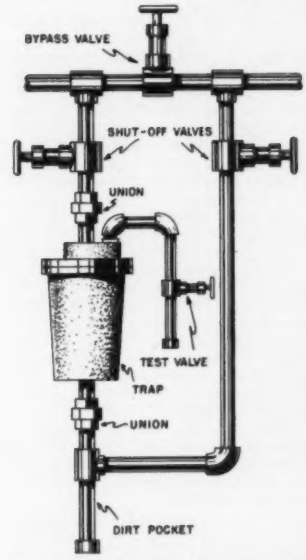


Fig. 3. Standardized hookup for trap used in conjunction with a bypass

traps where it is not desired to invest in the cost of strainer, though the strainer is to be preferred.

In installing traps, it is advisable to locate them where servicing will be convenient, if at all possible. This will help encourage their proper care. A trap located in an out of the way place or hidden from view is the trap more likely to be neglected.

Traps should always be installed below and close to the equipment or pipe line being drained, if possible. Be sure to note the inlet and outlet connections, as mistakes have been made in connecting traps, even by experienced pipefitters. Also see that the trap is plumb vertically. A leaning trap may function sluggishly due to friction of internal operating parts.

Where gravity drainage to the trap is impossible or impractical, the trap should be installed as shown in Fig. 4. A check valve and water seal ahead of the trap will prevent back flow of prime from the trap. If desired, an internal check valve may be installed in the trap body inlet on some traps. This takes the place of the check valve shown.

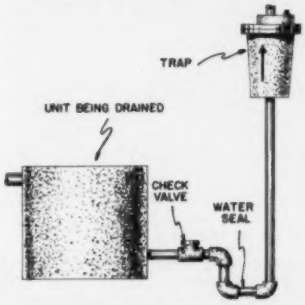


Fig. 4. Where gravity drainage to trap is impossible this method of installation should be used

Where the trap must be placed some distance from the unit being drained steam binding will occur, since the steam in the drain line must first be condensed before water can reach the trap. By installing a vent line as shown in Fig. 5, however, this difficulty can be eliminated.

Where condensate must be elevated to a return line, it is necessary that the differential pressure (trap operating pressure minus back pressure in the return line) be equivalent to ½ lb per ft of lift.

With some exceptions, steam heated equipment will heat faster and hotter if a separate trap is provided for each piece or each heating unit. Individual trapping insures positive steam circulation, proper air elimination, and freedom from short circuiting and resulting air binding.

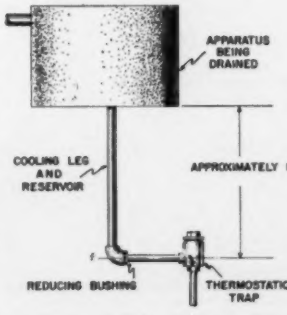


Fig. 6. Connections for thermostatic trap

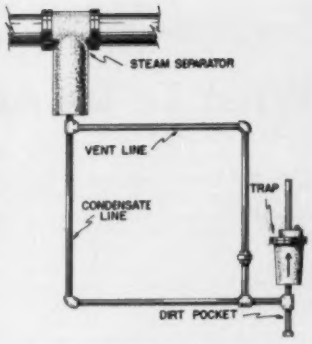


Fig. 5. Showing the use of a vent line

In connecting thermostatic traps, provide a cooling leg and storage chamber for the condensate between the apparatus being drained and the trap, as shown in Fig. 6. This part of the piping should be the same size as the apparatus condensate outlet and at least 18 inches long, longer if possible. Where space does not permit a vertical length of 18 inches, make up the difference by adding horizontal piping, or use a larger size of pipe.

Thermostatic and liquid expansion traps, provided they discharge to atmosphere and have no long discharge piping, require no protection against freezing, as no water remains in the trap. But other types of traps must be protected. Insulation can

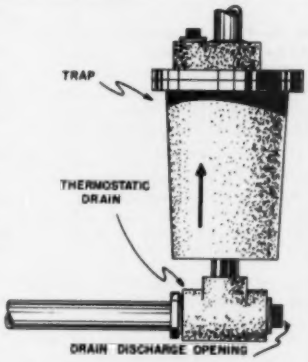


Fig. 7. Showing use of an automatic thermostatic drain

be used to protect traps that are in continuous use. An automatic thermostatic drain can be used to protect certain types of traps having a bottom connection, as shown in Fig. 7. All traps subject to freezing temperatures should be provided with a short discharge line, and horizontal pipe runs should be avoided.

Editor's Note—This is the first of two articles on the care and operation of steam traps by Mr. Thomas. Another, dealing specifically with the inspection and operation of traps, will be published in a subsequent issue.

Smoke—What Causes It and What To Do About It

SMOKE means only one thing — improper combustion. Knowing the principles of combustion, it should, therefore, be a simple matter to eliminate smoke; where the basic formula for the prevention of smoke is satisfied, smoke cannot occur under any conditions or with any fuel however high the volatile. Unfortunately, while the formula is simple the component factors are not easily derived.

Basically, there are four factors that have to be co-ordinated in the combustion of fuel to prevent smoke. These are:

T_1 = time
T_2 = temperature
M = mixture
A = air

If the exact or desired value of each of these could be maintained, smoke prevention would be easy. In practice, however, it is often very difficult or impossible to obtain the values required or to maintain the ratios necessary to prevent smoke. In the accompanying chart, compiled by Plibrico Jointless Firebrick Co. of Chicago, and reproduced here by special permission are given seven general conditions under which smoke may occur. Each of these conditions, it will be noted, may be due to one or several of a number of factors. Every cause of smoke is a violation of the fundamental formula embracing the four factors listed above.

This chart deserves careful study. It takes the mystery out of smoke and provides a shortcut to the prevention of smoke. Itemizing the many factors involved it brings out forcefully the inter-relationship between the mixing of air, the quantity of air, the disposition of the air in the furnace, and the temperatures involved.

It emphasizes the fact that a change of load or some other variable in operating conditions changes the equilibrium of combustion. On the supposition that equilibrium represents maximum fuel saving and minimum waste, any variation increases preventable loss.

The chart may be very useful where it is necessary to find out why smoke is occurring and to determine what conditions must be modified to stop it. It should be noted that no reference has been made to carbon dioxide (CO_2) or draft over the fire. These have been omitted because, while these are very important, they are only a means to an end and will vary with each different installation.

For every classification of coal and every size, there is a definite over-fire and under-fire draft that gives the highest efficiency for a given load or rate of combustion. The same holds true of CO_2. The reason CO_2 and draft are so important is that once the ideal values are known it is a relatively simple matter to maintain them under different conditions. In this way, operating conditions become standardized and economy assured.

Tear out the smoke prevention chart on the opposite page. Tack it up where it can be seen. The better the chart is understood, the better operation will be.

Editor's Note: Copies of the Smoke Prevention Chart are available on thick board with hole punched in the top suitable for hanging up on the boiler room wall. Copies of this chart will be sent upon request without obligation or cost. Address Editor, POWER ENGINEERING, 110 S. Dearborn St., Chicago 3, Ill.

SMOKE PREVENTION CHART

CAUSE OF SMOKE	INDICATED REMEDY
Lack of draft.	Increase height of stack. Increase capacity of blower. Operate dampers properly. Increase area of breeching. Decrease infiltration of air. Clean gas passages in boiler. Clean clogged ash pit. Decrease length of breeching. Eliminate bends in breeching. Decrease excess air entering around furnace or through fuel bed.
Improper furnace design.	Increase furnace volume. Increase furnace height. Correct location or height of bridge wall. Correct height, length, or pitch of ignition arch.
Excessive combustion rates.	May compel use of additional boilers, forced instead of natural draft, or revised methods of firing. Change of fuel. Correct distribution and mixing of air with volatile. Additional air for complete combustion.
Improper air distribution at fuel bed.	Level and clean fires eliminating holes and lumps and obtaining free air-flow through fuel bed and more uniform distribution. Introduce overfire air with PROjet system to bring about adequate mixing of combustible with oxygen. Accelerate mixing of oxygen and volatile with PROjet. Eliminate air leakage at rear between fuel bed and dump plate, etc.
When cleaning fires.	More careful use of slice bar and operation of dump plate. Minimize mixing of incandescent fuel with green coal. Keep fuel bed more uniform; do not allow clinker masses to form. Regulate firing. Clean more carefully in the case of hand-fired furnaces. Regulate stoker feed for better coal distribution.
When starting up.	Feed green coal more slowly until furnace arch and walls have sufficient heat to accelerate ignition and combustion.
Incorrect coal.	Use coal with less volatile or slower-burning characteristics. Use smaller sizes. Fire "light and often" by the "spread and alternate" method where hand-fired. Wet coal before using to create a more porous and homogeneous fuel bed and to lessen avalanching.

Chart, Copyrighted 1951 Plibrico Jointless Firebrick Co.

CONTACTS for testing can be made from lead pencils sharpened at one end to make a contact and at the other the lead is drilled out of the wood for one inch. The wires from the testing set should be bared for half an inch and this pushed in the recess formed. The wires should be sealed in place with a paste made from powdered graphite and gasoline, for the length of the bared wire. The gasoline will soon evaporate, then the rest of the recess should be filled level with molten paraffin wax.

The Last Fractional Grains Are Just As Hard!

Lime-soda boiler water treatment at the Studebaker Corp. is supplemented by phosphate finishing to zero hardness

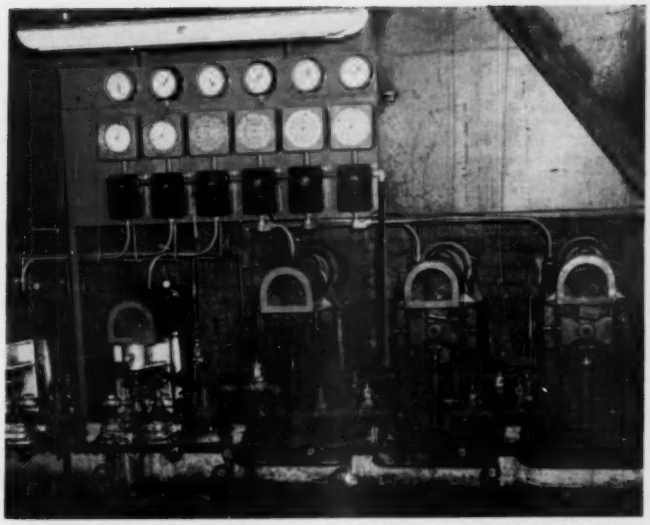


Fig. 2. Six SR plunger-type pumps and Flexopulse timers (five in service, one standby) supply phosphate finishing automatically to Studebaker boiler water. Upper dials indicate boiler pressures

EVERY power plant engineer is haunted by the specter of down time, the necessity for removing incrustations from boilers and turbines. And though this evil may never be completely eliminated in areas where water supply is hard, there are many ways of substantially reducing the hardness.

At the Studebaker Corp., South Bend, Ind., for example, softening procedures had for years been accomplished within the boilers — necessitating cleaning sometimes as often as every 30 days. Studebaker's original water averages about 22 grains of hardness, with some as much as 30 grains; and in an average month some 169,000,000 lb. of water are evaporated.

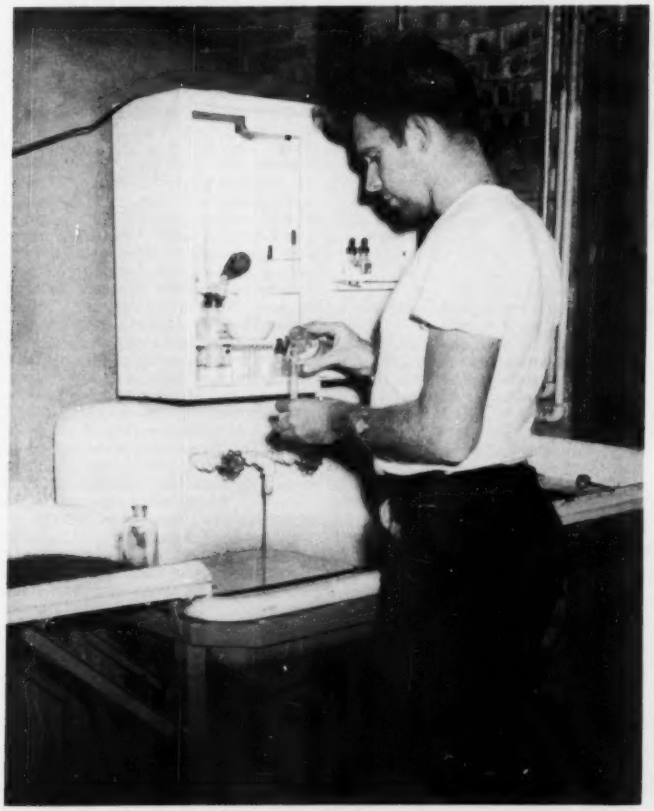


Fig. 1. Boiler water samples are quickly analyzed twice during each factory shift, to determine amount of phosphate addition that may be necessary

First Got It Down to 0.7 Grains

Somewhat over a year ago, Studebaker added a hot process lime-and-soda feedwater treating system, housed in a new building especially for this purpose. The lime-and-soda process is speedy and low in cost. Studebaker can soften 470,000 lb of water per hour — substantially more than the system could possibly require — and after the lime-soda treatment the hardness ranges from 0.7 to 0.9 grains. While this is a most creditable accomplishment, Superintendent of Power Plants John M. Bowman realized that 0.7 grains of hardness could, over a period of time, do just as much harm as 22 grains. The lime-soda treatment was greatly lengthening the time cycle in which boiler cleaning would be required, but it could not totally eliminate the need for this work.

Solution to the problem was obviously a finishing treatment to attain zero hardness, if this could be accomplished with little effort or expense.

"In such a situation," declares Bowman, "the practical answer is to put the problem up to a specialist. We knew such a man — a chemist associated with the Dearborn Chemical Co., who had solved other water treatment problems for us successfully."

A phosphate treatment was developed: a carefully balanced formula, just on the edge of alkalinity, which could be controlled by quantitative addition. The formula had to avoid creating a "phosphate condition," potentially as annoying as hardness incrustation. As perfected, the treatment actually delayed its softening action until the boiler water was in circulation.

Next:—Phosphate Treatment

The phosphate is added directly to the water in the boilers through SR plunger type pumps controlled by Flexopulse timers. The battery of six pumps, Fig. 2, comprise three with 1½-in. plungers, motor driven on 220-v line and three with 1-in. plungers on 110 v. The piping and valving are so arranged that only five pumps are in use at any time, with one ready for standby service, and seven boilers may be served.

Amount of phosphate to be added is determined from a chart of the supplier's recommendations, and is controlled by the number of minutes per hour that the timer permits the pump to operate, as well as by the size of the plunger.

Result:—Zero Hardness

Water samples are drawn from each boiler twice during each factory shift and immediately subjected to methyl orange and other tests to determine alkalinity, phosphate and salt content. The phosphate is controlled at between 20 and 60 ppm, and total dissolved salts at not over 150 grains.

Addition of the phosphate actually creates a small amount of "mud" in the boiler, but this has a sandblast effect on the turbine blades rather than sticking to them, in the 400–500-F steam produced by the boilers.

The desirable end result is boiler water at zero hardness, with cleaning of the boiler necessary only at infrequent intervals — and then, accomplished with ease.

More on Simultaneous Firing of Midwest Coal and Natural Gas

In February, a reader asked in Question No. 478 how this could be done when the coal is burned on chain-grate stokers. . . . A new installation of this type, also the experience of Kansas City Power & Light Co., were given in the August 1951 issue. . . . Now we present some very practical data from Iowa Power and Light Co., showing how they have equipped six 1500-hp boilers in one plant to burn gas over chain-grate stokers. . . . Initial design was for rear-arch gas firing, but a front-arch installation proved simpler, less costly, better to operate. . . . Front-arch firing method very successful over 5 years. . . . At full boiler rating, plant burns up to 80% of fuel demand as natural gas (when available), 20% as coal

By L. L. MOWEN

Assistant to Vice President in Charge of Power, Iowa Power and Light Co.

AT IOWA Power and Light Co. we have been quite active in the past few years in studying ways and means of burning natural gas in conjunction with coal.

In 1946, study was started on application of natural-gas burners to our six 1500 hp, 365-psig, 700-F, chain-grate-stoker-fired boilers. Three of these are B. & W. boilers, two are Heine boilers and one is a Walsh and Weidner boiler. All six are of similar design and size. They are single-drum, sectional-header, three-pass boilers with horizontal, convection-type superheaters. All have side water walls and employ Illinois chain grate stokers.

Original Design for Rear-Arch Firing

Study indicated that gas firing through the rear arch might be practical if the proper air supply for both the gas fuel and the stoker fuel could be obtained from the same source, one forced-draft fan per boiler, and could be correctly controlled to meet load changes. An automatic control method was developed and installation was started.

Eight air ducts 1 ft wide by 2 ft high were installed through the rear arch, uniformly spaced, and about 8 ft above the stoker chain. These ducts received air from the forced-draft fan by damper control, according to the amount of gas fuel being fired. The remainder of the forced draft air was supplied as previously, under the stoker, according to the coal fuel demands.

A burner made from 2-in. stainless steel tubing 24 in. long, with two rows of 1/16-in. holes drilled 60 deg apart, was installed in each air duct and centered vertically in the duct. Ventite type pilots were installed beside each burner. Gas was fed to the burners from a 6-in. burner header, which, in turn, was supplied from an 8-in. loop header around all six boilers. Gas fuel supply control was by means of a 6-in. diaphragm-operated control valve in the burner header supply line.

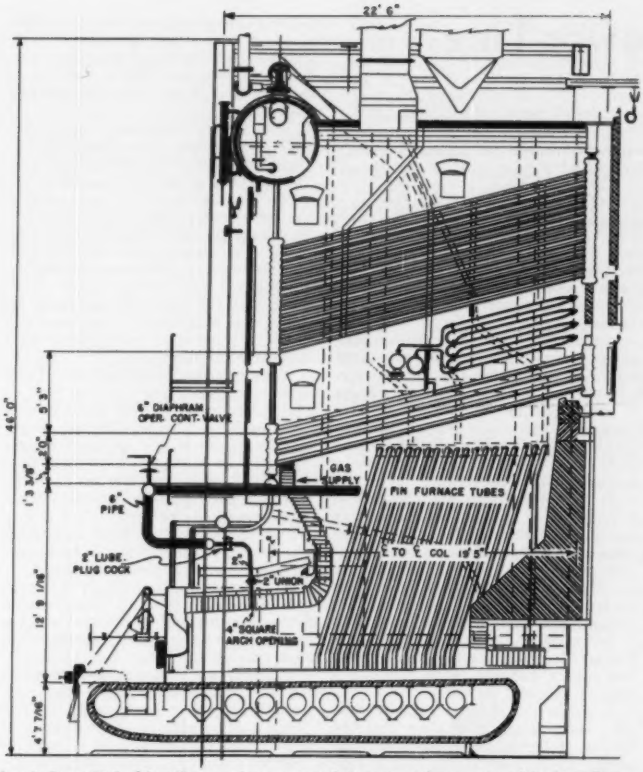
Necessarily, this installation was quite time-consuming, due to duct work, damper fabrication and rebuilding of the rear arch to accommodate the air ducts. It is not shown in the drawing for reasons that will quickly appear.

Design for Front-Arch Firing

In the meantime, we were quite desirous of burning natural gas immediately on the stoker-fired units; so experimentation was continued. Out of this, the following method evolved and, due to its simplicity and low cost, it was tried immediately. Through the front arch, as close to the "bull nose" as possible, 14 burners were installed. These were made from 2-in. pipe flattened at one end to give a ¼-in. opening about 2½ in. long. The arch openings were made by leaving out a 4-in. section of the upper tier of arch brick and by cutting out adjacent corners of each of 4 lower-tier arch brick. There are 27 arch tile across the width of the arch, so we entered a burner through every other section.

The burners were so arranged that they tended to direct the gas flow down toward the stoker chain and slightly toward the rear of the furnace. The flattened burner tips were coupled to 2-in. feed lines, which in turn were attached to the 6-in. header by 2-in. lubricated plug cocks and short nipples. The entire burner assembly, header and valves was supported by pipe hangers. An ordinary 6-in., 125-lb gate valve in the supply line to the burner header was used as a firing valve. An extended handle on this valve permitted control by the fireman from the firing aisle. This set-up was completed before the previously-explained rear wall installation, and gas burning over the chain-grate stokers started immediately.

The fuel bed on the stoker was cut to a 4-in. depth and the stoker speed was reduced to a minimum. This method of firing proved very satisfactory. The forced-air dampers under the stoker were adjusted by experi-



Here is the method of installing gas burners over chain grate stokers, now used by Iowa Power and Light Co., Des Moines, Iowa, to burn coal and gas simultaneously. Burners and piping fabricated in plant. This front-arch firing method, first tried to burn gas immediately, proved better than a more elaborate rear-arch installation. This method now used on all six 1500-hp boilers at this plant

mentation to give air at the proper places for most economical firing and we now burn up to 80 per cent gas fuel very easily with this system. Since no pilots were included in this installation we always carry at least a 4-in. coal fire for safety purposes. This 4-in. fuel bed, with stoker at minimum speed, amounts to about 2 to 2½ tons of coal per hour.

In addition to supplying the pilot system for safety, the coal fuel furnishes an ash bed over the chain grate that helps to protect it from the furnace heat. In emergencies, we have fired 100 per cent gas over stationary chains, but we have found that such a practice, if continued for any considerable length of time, produces grate disintegration in spots directly below the gas burners. The ash at these spots fuses together and leaves exposed chain, which eventually becomes damaged. We have not as yet experimented with burning 100 per cent gas over a moving chain, for no pilot system is yet installed to protect such operation.

With respect to firing through the rear arch, this installation was nearing completion, so even though gas firing through the front arch was very successful, we completed the rear-arch job and put it in operation. This method also proved successful. There were no tailing flames in the superheater and control was good, as was economy in operation. However, we found that when no gas was being burned, the burners in the back wall were subjected to too much heat as no air was passing them and they eventually burned up. Also, the duct work around the burners warped considerably for the same reason.

Front-Arch Firing Beats Rear Arch

Because of these disadvantages and because of comparative installation costs, the rear-arch firing method was eliminated. The other 4 boilers were made to fire gas through the front arch as above and, eventually, even the one rear-arch installation was removed. Now, all six of our 1500-hp chain-grate units fire gas through the front arch. The 6-in. gate valves have been replaced with diaphragm-operated control valves. Three boilers have been made completely automatic for all loads above the base coal load, and the other three boilers are automatic for any specific base load. This specific base load must be manually set. Of the three automatically-controlled boilers, any one, two or all three can be used to control the load swings.

Operating Results

About the only disadvantage we have experienced in firing through the front arch is that the 2-in. flattened burner tips do burn off. However they are inexpensive to make and easy to install, so this is not much of a disadvantage. At the same high ratings, we have less tailing flames in the superheater with gas than with coal, the stoker chain stays cooler and the superheat temperature is better. In addition, maintenance is less and slag in the steam generating and superheater tubes is reduced to a minimum. Side wall erosion due to gas flow from the outside burners was eliminated by eliminating a burner and changing burner entrances through the arch to place outside burners farther from the walls. We have found that we can improve our coal burning when using small amounts of gas, apparently because of the increased turbulence caused by the gas. This gas enters by crossing the plenum box or secondary air stream flowing along the arch tile, and seems to agitate the gaseous mixture advantageously.

We consider the experiments very successful as proved by the past 5 years' experience. At full boiler rating, we can burn up to 80 per cent of the fuel demand as natural gas, when gas is available. The other 20 per cent is coal of approximately the following analysis.

Moisture	16.5%
Ash	17.5%
Volatile	30.0%
Fixed Carbon	36.0%
Total	100.0%
Sulfur (Separate Determination)	4.5%
Btu per lb	9200
Ash Initial Def.	1753 F

PAUL SCHMIDT'S FUEL OIL ARTICLES AVAILABLE IN BOOK FORM

Readers who were interested in the series of articles by Paul F. Schmidt on the characteristics of fuel oil, which were published in POWER ENGINEERING from April 1950 to May 1951, will be pleased to know that this material has now been published as a book under the title of Fuel Oil Manual. This book, which has been published by The Industrial Press, 148 Lafayette St., New York 13, N. Y., includes the material in the original articles together with material from the standards of the American Society for Testing Materials. The price of the book is $3.50. Order your copy direct from The Industrial Press.

Don't Neglect Power Line Maintenance

Power Companies are required to use reasonable care in the construction and maintenance of lines and apparatus. Law holds them responsible if they don't

By ALBERT WOODRUFF GRAY

PEOPLE living at Powellsville, North Carolina one night saw electric flashes of fire on the power wires of the Virginia Electric & Power Co. leading into the plant of the Carolina Peanut Co. The current arcing close to the buildings of this company foretold with certainty a fire within minutes unless the current was shut off.

The manager of the power company at Ahoskie was told by telephone of the danger, the need of immediately cutting off the current and that unless this was done and no time consumed in investigating, this plant would be afire.

Disregarding this warning, the power company manager told his assistant to investigate. Before the assistant arrived these buildings were in flames, with an aggregate loss in buildings, equipment and other property of a quarter of a million dollars.

In defense of the action brought by the owner of this property for the power company's negligence in failing to cut off immediately the current from these overcharged wires, it was contended that before shutting off current when trouble of this character arose, it was the practice always to first investigate.

Under the law, said the court, it is the duty of the power company to do all it reasonably can to protect these buildings from the consequences of fire from this excessive voltage. After such notice was received the company could and should have acted with reasonable dispatch and efficiency and taken such precautions as a reasonably prudent man would have adopted under the circumstances, continued the court, holding the power company liable for these damages.

In contrast with these facts under which the power company was held responsible for the fire from overcharged wires, was another incident in that state in which the Carolina Power Co. was held free of liability for the failure to shut off the current from arcing wires leading into a warehouse in Henderson.

This power company maintained a substation two miles from this warehouse, from which primary wires transmitted the current to transformers, attached to a pole across the street from this warehouse. There the current was stepped down to service voltage and carried across the street to poles 15 or 20 ft from the warehouse where connection was made through a conduit with the wires leading into the building.

A storm on a winter night covered these wires with sleet and ice. In the morning before daybreak the arcing of these wires was followed by the dull, heavy report of an explosion inside the warehouse, followed by a burst of flames through the roof.

The warehouse owners in the suit brought against the power company contended that the fire was caused by broken and tangled wires dislodged by unusual weather conditions and by the failure of the power company to shut off the power.

The company in its defense maintained that the fire, if it was caused by electric current, came from a short circuit in the building; that the condition of the wires was due to the fall of a tree limb from the weight of the ice and sleet but that when that incident occurred, the fuses in the transformers had blown and the current cut off.

The power company, said the court, was free from liability for negligence but if it had received notice that the secondary wires leading from the transformers and serving the warehouse, were arcing, flashing light and giving other indications of being overcharged and the condition was sufficiently dangerous to require cutting off the current over those wires, and the company had failed to do so, and such failure had been the cause of the fire, it would have been liable for the loss.

"Necessarily," said the court, "the power company permits the flow of electric current over its wires in volume sufficient to cause fire under some conditions and in the transaction of the business for which it is created, it may lawfully do so without incurring liability unless it be in some respects negligent in so doing, being under the duty of exercising the degree of care that is commensurate with the dangers involved."

This care required of power companies in relation to overcharged wires, outlined by a North Carolina court 25 yrs ago, clearly summarizes this rule of law.

"Electric companies are required to use reasonable care in the construction and maintenance of their lines and apparatus. The degree of care that will satisfy this requirement varies, of course, with the circumstances, but it must always be commensurate with the dangers involved; and while the wires maintained by the company are designed to carry a strong and powerful current of electricity, the law imposes upon the company the duty of exercising the utmost care and prudence consistent with the practical operation of its business."

References

Virginia Electric & Power Co. v. Carolina Peanut Company, 186 Fed. 2d 816, North Carolina, February 3, 1951

Fleming v. Carolina Power & Light Co., 61 S.E.2d 364, North Carolina, October 11, 1950

Calhoun v. Nantahala Power & Light Co., 4 S.E.2d 858, North Carolina.

The current arcing close to the buildings foretold certainty of fire

POWER COMPANY RESPONSIBLE FOR INJURY TO TRESPASSERS

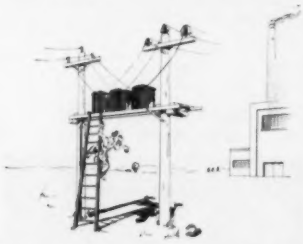
By FRANCIS GEORGE

ELECTRIC POWER COMPANIES are responsible if people are injured on power company property, although the people may be there without permission and for no purpose of the company.

Last winter Oliver La Duke an electrician employed by the Lakeside Aluminum Co. plant at Eau Claire, Wisconsin was injured at a bank of Northern States Power Co. transformers; he sued the power company and won.

This bank of three transformers rested on a channel iron high above

the ground between two poles; there was also a raceway some distance above the ground. Power at 2300 v came in on the primary side of the transformers and a 460 v circuit went out to supply a soy bean plant located next to the Aluminum Company. The electrician was running some conduit for the Aluminum Company and he was fastening it to brackets under the raceway. He had run his line from the plant and set a ladder against a power company pole where



A surge of current went through him and he fell to the ground

he was working planning to connect and attach additional conduit when he reached out and touched the channel iron with one hand to balance himself while holding to the raceway with the other. A surge of current went through him and he fell to the ground seriously injured.

He lived to testify that a ground wire ran from the channel iron down one of the supporting poles where it was attached to a coppered and welded rod driven into the ground; that it appeared properly fastened to him and should have rendered the transformers and channel iron dead. About two weeks after the accident, La Duke's foreman checked the ground wire with a voltmeter and found that it was carrying 375 volts although it should be carrying only a trace. The wire proved to be disconnected from the grounding rod and coiled in the hole.

Northern States power contended that the poles and transformers were not a public building, that La Duke did not have permission to put his ladder there and was a trespasser when he did that. Furthermore, the power company contended that if he had more carefully examined the ground wire he would not have been injured.

The judges of the Wisconsin Supreme Court agreed that the poles and transformers were not a public building, but they said La Duke had a right to be there. Justice Hughes said: "Whether it placed its transformers after the Aluminum Company erected its raceway or whether the raceway was erected subsequently, the power company must have had knowledge of their close proximity and should have anticipated that the Aluminum Company might engage workmen in the maintenance of its electrical conduits who might come in contact with the Power Company equipment. It was its duty to maintain its equipment in a safe condition."

In another Wisconsin case a 14-year old boy was killed when he was playing on top of a pile of lumber over which a power company had uninsulated wires running. The boy had no business on the lumber, nor reason to touch the wires, but the judge said that the company should foresee that someone might touch the wires. Which means that no power company equipment should ever be left in a dangerous condition, even if it is on company property where no one but company employees are supposed to be, or is suspended where no one but a foolish kid would play with it.

MODERN POWER EQUIPMENT RELIABLE; IS THE OPERATOR?

By WILLIAM SHEFFER

AN INTERESTING FACT about power plant machinery, in general, is the amazing reliability of the major pieces of equipment. Most all outages are caused by the smaller, auxiliary equipment. Another cause of shutdowns, outages and emergency calls is the operators' unfamiliarity with the details of the equipment. Lack of training, loss of interest in the work, are contributing factors to this condition. Generally, the operator is not basically at fault. Quite often, leadership in the organization is lacking, and the operator has no promise of reward nor consideration for his efforts. What should be a way of life becomes a strictly bread-and-butter proposition.

Here are a few occurrences that were the cause of emergency calls and somewhat serious outages. The causes obviously were quite simple, the conditions inexcusable. They may interest newcomers in the field, and be of reminiscent interest to old-timers.

Trouble: Solenoid-powered oil circuit breaker would not close.

Cause: Interlocking synchronizing plug not in circuit.

Trouble: Hydro unit would not pick up load.

Cause: Unit disconnects were open, and not tagged to operator.

Trouble: Industrial engine generator would not maintain voltage under load.

Cause: Main field rheostat was left in circuit.

"I dunno — I'm getting eyestrain watchin' 'em"

Trouble: Exciters, in parallel on bus, would not share load.

Cause: Type "T" voltage regulator in service. Operator did not understand use of equalizer rheostats.

Trouble: After shutdown due to loss of load, hydro unit would not start.

Cause: Hydraulic lock out on governor pilot valve functioned perfectly, and operator did not know of its existence.

Trouble: Draw bridge would not open.

Cause: Fuse blown in main motor control circuit.

Trouble: "Unexplainable" increase of concentration in boiler water.

Cause: "Fireman" did not know purpose of blow down valve.

Trouble: Steam engine unit would not pick up speed.

Cause: So help me, "Engineer" was using throttle by-pass only.

Trouble: Air compressor bearing burned out.

Cause: No oil in crankcase.

Trouble: "Type T" voltage regulator hunting badly.

Cause: Dashpot loaded with gummed-up 600W.

Trouble: Traveling crane would not operate.

Cause: Main switch open.

Trouble: Synchroscope out of order. Turbine had shut down, overspeed tripped.

Cause: Operator did not know enough to release compression on governor spring.

Trouble: Operator could not remove unit from line without blackout.

Cause: Exciters were in parallel; he was trying to shut down unit without clearing exciter from board.

And so on, for 30 years.

PRACTICAL HINTS AND KINKS

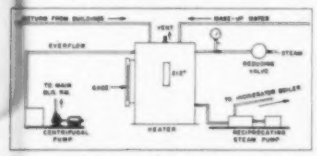
HOW WE LICKED RETURN CONDENSATE LINE CORROSION

By EDGAR V. LEWIS
Assistant Plant Engineer
American Optical Co.

FOR REASONS which will be discussed later a new condensate return line approximately half a mile long was installed some time ago. After a short time leaks appeared at the couplings and constant repairs were necessary.

We felt that the reason for the installation was sound and set about correcting the conditions that caused the trouble. A study of the problem, aided by consultants, indicated that the trouble was probably caused by dissolved oxygen, carbon dioxide or both.

Of the two oxygen is worse. Experience shows that a very small quantity of oxygen will attack, and, in time eat out, a return line. Oxygen can enter the system from a number of sources. The water surface of the collection tank or receiver is a likely source for air surges in and out of the vent pipe as the tank is filled and emptied. In this case the most likely source appeared to be the make-up water added to the system.



Installation of a deaerating heater stopped serious return line corrosion

As a result we discarded the old collection tank and installed an open type deaerating feed water heater. The water temperature is now controlled at 210 F. or better which drives off the bulk of the oxygen. This heater is equipped with both an overflow and makeup control to maintain the level in the heater. The treatment was effective and cured our corrosion troubles in the line.

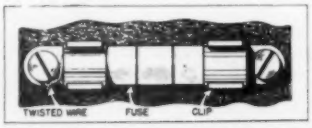
This condensate return line runs between the main power house and the old boiler room. The latter is now used as an incinerator to dispose of wastepaper, crating and scrap. A certain amount of heat is recovered in this way. The steam generated is used to heat nearby buildings.

Returns from these buildings are piped back to the boiler room and used for boiler feed. Originally the overflow was wasted to the sewer. The water had been treated however and was relatively free from impurities.

The condensate return line was installed to reclaim this water and return it to the main power house. This was accomplished by piping the overflow to a return pump which delivered it to the return line. Makeup for the incinerator boilers is added to the collecting tank as needed. The hook-up, with the new deaerating heater, is shown by the drawing.

WIRE WILL SECURE FUSE CLIP

FUSE CLIPS sometimes fail to make good contact with the fuse ferrules, resulting in heating of the clips and drawing of the temper, which may result in poorer contact or needless blowing of fuses. By twisting a short length of about 18 gauge wire around the base of each clip, the tension of the clips and their hold on the fuse ferrules will be increased.

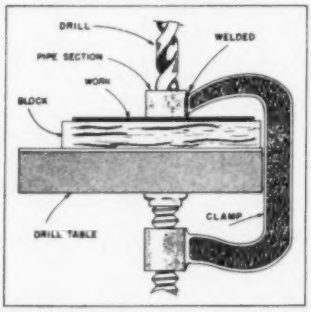


Length of twisted wire around base of clip will increase tension of fuse clip

CHUTE RACK STORES AND FEEDS WORK

A total of 130 motor frames are stored in this chute rack preparatory to welding. Frames roll from rack onto a pneumatic-lift table (arrows) that automatically delivers them to stand in front of operator for job of welding (Westinghouse photo)

HANDY DRILLING CLAMP

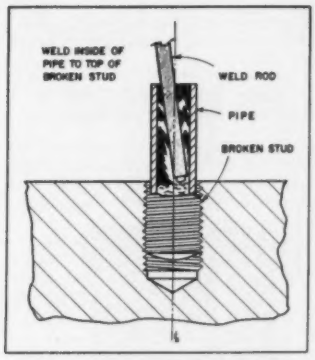


By removing anvil end of ordinary steel clamp and welding on short section of steel pipe, a handy clamp can be constructed for drilling thin metal. This clamp furnishes full support to the metal and helps prevent its distortion

TWO HELPFUL HINTS FOR REMOVING BROKEN BOLTS, STUDS

By G. L. CROSSETT

A KINK USED for removing broken bolts or studs below the surface is to insert a short pipe into the hole and weld the pipe, with weld rod inside, to broken stud. This is also effective on studs which are badly rusted. The heat developed by the arc is sufficient to cause the stud to



Easy way to remove any broken bolts

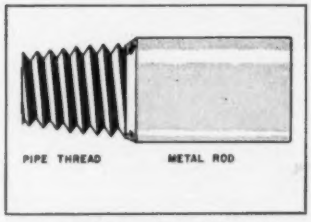
shrink slightly upon cooling. A pipe wrench can then be used for backing out broken stud.

By W. E. WARNER

HERE is another approach to the same problem. The contributor suggests getting a very thin sheet of copper and bush around the parts of the hole not covered by the broken bolt. Then fill up the space left between the grooves of the bolt and the walls of the hole with machine oil up to the level where the bolt is broken. This is done to prevent the iron cement from joining to the walls of the hole. The space between the top of the bolt and the copper bushing should be filled with iron cement. Build up the iron cement to well above the top of the hole and insert a rod of iron or steel. Allow cement to harden for from 24 to 48 hours. The rod will then be firmly joined to the bolt so that it can be screwed out easily.

HOMEMADE PIPE PLUGS

WHEN A NEEDED size of pipe plug is not at hand, or when a pipe plug must be removed and replaced frequently, it might be well to make your own. A practical pipe plug can be made by threading one end of a metal rod of suitable diameter, then



Homemade pipe plug helpful in pinch

cutting to desired length. If the rod used is somewhat larger in diameter than the size required, this can be advantageous, since one end can be turned to proper size for threading while the larger, unthreaded portion will provide an ideal grip for a pipe wrench.

LEAKY PIPE OR SEEPAGE? YOUR WATER TESTING KIT WILL TELL YOU FAST

By L. W. FITZPATRICK

CONVENTIONAL water testing equipment for boiler and allied water treatment control can be used with success by the power plant maintenance engineer to determine quickly whether water leaks and seepage into a building and ground area are caused from defective plant water-supply system piping. Nothing to buy; you just use what you already have.

Water-supply sources are much like fingerprints, all different, and a plant source is definitely different from rain-water or overflow from a river.

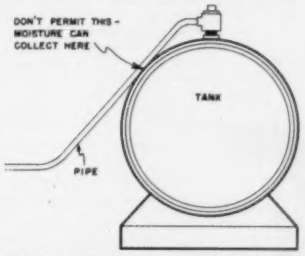
Comparatively rapid analysis of the plant source, matched against a sample from the suspected seepage or water puddle, quickly checks alkalinity, chlorides, and hardness and tells if they are one and the same water. Water passing through the earth to different localities in a plant area is not appreciably altered in its chemical composition from the original.

During recent floods and rains in Missouri, a test was made of 18 different water deposits in various locations in our plant which were suspected of being leaks. Seven were determined to be plant piping leaks; nine were overflow and seepage from the rivers; one was from a leaky sewer line from a softened-water department area; and one was from a spring that always before had escaped identification and location, for we had believed it to be a continual seepage.

It seems to me this procedure should have wide use in industry, for practically every plant already has the equipment and can use it to this additional advantage, saving lots of time and expensive digging.

KEEP SWEATING PIPES AWAY FROM OTHER METALS

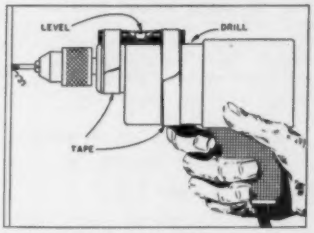
WHEREVER possible, it is advisable to keep pipes subject to sweating separated from adjacent metal ob-



With pipe resting on metal tank, as shown, moisture accumulating at contact point might corrode both. Remedy:—Keep them separated

jects. This will help minimize corrosion of both metals by preventing accumulation of moisture between the metal surfaces. The sketch shows a typical situation where sweating could cause such corrosion.

LEVEL YOUR DRILL



A small level, taped to the case of an electric drill, will provide a level guide when drilling in a horizontal position

PIPE CAPS ARE HANDY RECEPTACLES

Pipe caps, in sizes above one inch, make handy receptacles for pipe thread compound, graphite bolt thread grease, etc., because their weight and shape make them rather difficult to overturn

CROSS BARS ON WRENCH SAVE FINGERS

By F. BESHENICH

IN PULLING down transformer jobs after assembly, a hazard presented

Operator's fingers are spared possible injury by cross bars welded to wrench

itself for the assembler holding the lower nut on tie rods. These rods are tightened by pneumatic impact wrenches.

To prevent the operator's hand from becoming wedged between the end wrench and the transformer frame, cross bars were welded to the wrench. As a result, these bars hit the frame and protect the fingers of the man holding the wrench.

"HUSHER" FOR OIL BURNERS PACIFIES NEIGHBORS

By ARTHUR HOLT

HAVE ANY readers ever wished they could silence noisy oil burners? If so, possibly our experiences in that line will interest them.

Our boiler room is directly across the street from a hotel. When a certain type of oil burner was installed in our plant by the owners, we received violent complaints from the hotel. It appeared we would have to keep the boiler room doors and windows closed all summer to avoid disturbing the hotel occupants. Needless to say, this would have made the heat in the boiler room almost unendurable.

We asked the representative of the oil-burner manufacturer if he knew any way to silence the burners. He replied he did not.

In looking around for a way to tackle the job ourselves, our first idea was an enclosure built completely around the burners. However, a good-sized opening for combustion air would have been needed, and this would have let the noise escape nearly as much as before. Therefore, a long air duct, reaching to some point far inside the building (so the noise would not carry outdoors) would also have been needed.

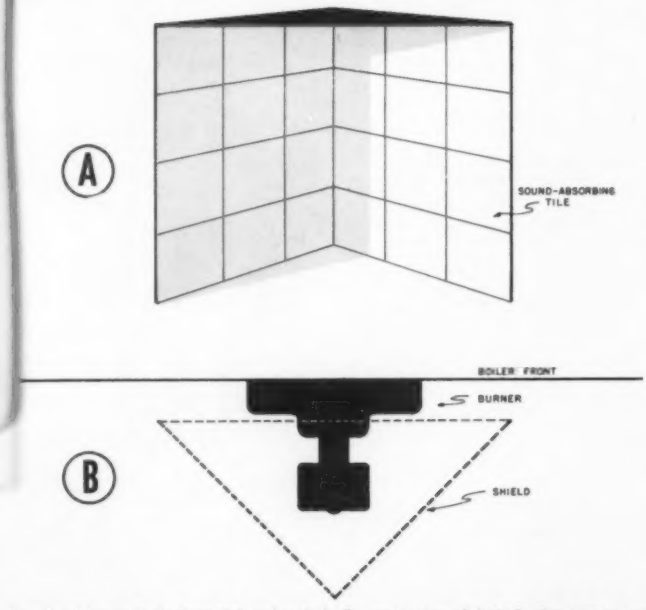
This idea was judged impractical — first, because the boiler fronts were a maze of piping and conduits and an enclosure could not very well be fitted around them; and second, because the enclosures and duct would take up too much room and be too much in the way when it was necessary to repair the boilers or burners.

So here's how we solved our problem: we made a sound-absorbing shield from angle iron and 12-gage steel as in A of the sketch. The entire inside of the shield was lined with sound-absorbing tile.

When the shield was pushed up close to the burner as in B, we found the noise — particularly the irritating high-pitched whine of the primary air fan — was do deadened that it was no longer objectionable outside the building.

At first we were afraid the shield might restrict ventilation of the burner motor, damper motor, relays, and other accessories on the boiler front, and might cause them to overheat. Accordingly we took temperatures of them with and without the shield in place. We found the shield did not cause them to heat perceptibly. This was explained by the current of air always flowing inside the shield on its way to the combustion air opening.

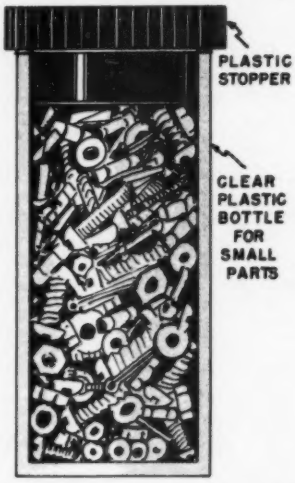
The shield was not fastened to the boiler, but merely stood on the floor. When necessary to inspect or repair the burner, it was easily pulled out of the way.



How the oil-burner "husher" was built and used. A—Perspective view of shield. B—Plan showing how shield is used

KEEP YOUR SMALL PARTS IN PLASTIC BOTTLES

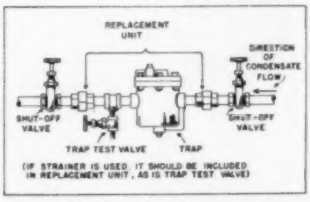
DISCARDED medicine bottles of the clear plastic type, having plastic stopper caps, make handy containers for assortments of small drills, taps, screws, nuts, washers, cotters, and the like carried in the tool box tray. Because the plastic is clear, the bottles permit the contents to be identified without opening them.



You can quickly identify small parts in your tool box if you carry them in discarded plastic medicine bottles

STEAM TRAP REPLACEMENT UNIT

WHERE A NUMBER of steam traps of the same type and size are in use, simplification in replacement can be achieved and considerable time saved by arranging the trap connections according to a standard, as shown. This permits defective traps to be removed from the line and replaced with an identical standby unit, without the delay occasioned by ordinary replacement procedures, involving the assembly of trap, fittings and accessories for each application.


REPLACEMENT UNIT
DIRECTION OF CONDENSATE FLOW
SHUT-OFF VALVE
SHUT-OFF VALVE
TRAP TEST VALVE
TRAP
(IF STRAINER IS USED, IT SHOULD BE INCLUDED IN REPLACEMENT UNIT, AS IS TRAP TEST VALVE)

By arranging trap connections according to a standard, defective trap can be removed and replaced with standby

Questions and Answers

Q & A—THE POWER ENGINEER'S FORUM—

HERE'S HOW IT WORKS

YOUR QUESTION about some problem in operation, maintenance or design will be published, signed only with your initials.

Answers to your questions from other readers will be sent you as soon as received, then published as space permits, so that all may have the information.

You, too, answer questions from other engineers in the same way. You get paid well for published answers and also get the credit for knowing them.

If other engineers help you solve your problem, you express your thanks, via the Q & A editor.

Simple, isn't it? And effective! Just ask engineers who have tried it!

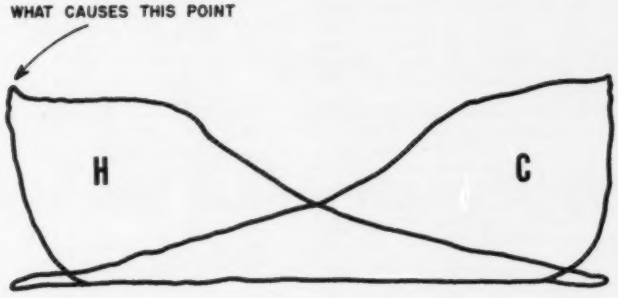


Diagram from right-hand cylinder of twin Corliss Engine, actual size as it came off the indicator

Steam Pressure at Boiler	157 psig	Throttle valve	Wide open
Diameter (bore) of cylinder	34 in.	Inside diameter feed pipe	12 in.
Length of Stroke	48 in.	Outside diameter exhaust pipe	14 in.
Diameter Piston Rod	9 in.	Scale of indicator spring	80
Revolutions per minute	100	Load	1000 kw
Back pressure	27 psig	Generator nameplate rating	2500 kva

Question No. 490

WHAT CAUSES POINT ON STEAM ENGINE INDICATOR DIAGRAM?

HERE IS an indicator diagram taken from a twin Corliss engine, right-hand cylinder, size 34 in. by 48 in., driving a generator. What causes the high point on the head end diagram? Is it serious? If so, how can it be eliminated?

Information and dimensions are given with the card. The engine drives a generator whose nameplate gives rating of 2500 kva.

Michigan O.H.D.

Editor's Note:—Rally 'round, all ye old-time Corliss engine men!—and let's have a game! Little did we think we'd see one of these cards again for Q & A comment. Yet everywhere we go we find the old reliable reciprocating steam engine still rendering what is called "yeoman" service in many industrial power plants. It always surprises us. But they can make some very low-cost kilowatt-hours when properly maintained and operated, especially if you can use some of that beautiful 27-psi exhaust in processes. Right now many plants need every one of these engine kilowatts they can get.

That head-end peak isn't too bad, seems to us, and not much adjustment is needed. Tell O.H.D how to get rid of it. We've already given him our ideas and we'd like to have you check them. The Q & A editor was vice-president in charge of wiping on one of these twin Corliss jobs, 'way back in his youth, and thinks he remembers some of the old Corliss valve lore—to say nothing of all the good dope in Croft, Pickworth, Thurston, etc.

Also, get out the area tables and oil up the slide rule and check the horsepower for O.H.D. Thanks.

Answer No. 485

CAN VERTICAL STEAM ENGINES RUN WITHOUT CYLINDER LUBRICATION?

Perkins Did It

MY OWN EXPERIENCE has been only with steam turbine and Diesel generator units so I can offer no direct answer to this question. However, the thought occurred to me that Ambitious Al, as well as some of your other readers, might like and be interested in a passage from an old book about an old, old timer and his steam engines. Please note the steam pressures this old boy was playing with some 125 years ago. The following is from Robert H. Thurston's book "A History of the Growth of the Steam Engine", published in 1878.

"As early as 1823, Jacob Perkins commenced experimenting with steam of very great tension. As has already been stated, the usual pressure at the time of Watt was a few pounds — 5 or 7 — in excess of that of the atmosphere. Evans, Trevithick, and Stevens, had previously worked steam at a pressure of 50 to 75 pounds per square inch, and pressures on the Western rivers and elsewhere in the United States had already been raised to 100 or 150 pounds, and explosions were becoming alarmingly frequent.

"Perkins' experimental apparatus consisted of a copper boiler, of a capacity of about one cubic foot, having sides 3 inches in thickness. It was closed at the bottom and top, and had five small pipes leading from the upper head. This was placed in a furnace kept at a high temperature by a forced combustion. Safety valves loaded respectively to 425 and 550 pounds per square inch were placed on each of two of the steam pipes.

"Perkins used the steam generated under these great pressures in a little engine having a piston two inches in diameter and a stroke of 1 foot. It was rated at 10 horse-power.

"In the year 1827 Perkins had attained working pressures, in a single-acting, single-cylinder engine, of upward of 800 pounds per square inch. At pressures exceeding 200 pounds he had much trouble in securing effective lubrication, as all oils charred and decomposed at the high temperatures then unavoidably encountered, and he finally succeeded in evading this seemingly insurmountable obstacle by using for rubbing parts a peculiar alloy which required *no lubrication*, and which became so beautifully polished, after some wear, that friction was less than when lubricants were used. At these high pressures Perkins seems to have met with no other serious difficulty. He condensed the exhaust-steam and returned it to the boiler, but did not attempt to create a vacuum in his condenser, and therefore needed no air-pump. Steam was cut off at one-eighth stroke.

"In the same year, Perkins made a compound engine on the Woolf plan, and adopted a pressure of 1400 pounds, expanding eight times. In still another engine, intended for a steam vessel, Perkins adopted, or proposed to adopt, 2000 pounds pressure, cutting off the admission at one-sixteenth, in single acting engines of 6 inch diameter of cylinder and 20-inch stroke of piston. The steam did not retain boiler pressure at the cylinder, and this engine was only

rated at 30 horsepower."

ROBERT G. CROSBY, JR.
Supt., Municipal Power Plant
Gainesville, Florida

Answer No. 488

WHY USE STEAM TO OPERATE TURBINES?

Comment by Evans

TURBINES depend on expanding of steam with a consequent loss of pressure and heat to produce work. There are turbines that use air but air has to be compressed before it can be expanded to do work so the overall result would be more power to compress air than power output from generator. Water can be used to drive a turbine but it delivers energy due to elevation head — only practical with large natural reservoirs with high head on turbine or water wheel.
Chicago, Ill. MELVIN EVANS

Answer No. 489

HOW TO MEET SHORT PEAK STEAM DEMAND

Accumulator Might Be Too Expensive

AN ACCUMULATOR seems to be an expensive manner to get the additional steam generation capacity. At 100-hp fired at 200 per cent rating, the steam output would be approximately 6000 lb per hr from 1 boiler; therefore, assuming 1000 lb steam is produced by the other boiler for the one-half hour period on peak load and that you can use steam at 80 psig instead of the 100 psig (an accumulator can only produce steam at a lower pressure than the boiler due to "flash steam principle") it would require a 900 cu ft vessel for a design pressure of 125 psig. The cost would be excessive; therefore, staggering operations or use of heat exchangers on waste hot water is recommended.
Chicago, Illinois MELVIN EVANS

How He Could Figure Accumulator

IT WOULD SEEM that W.O.T. could use a steam accumulator to good advantage. An accumulator must consist of certain essential elements to produce a satisfactory result. The accompanying sketch shows one type of accumulator.

The accumulator is charged by admitting steam through the charging line. When main line pressure falls, outlet check opens and supplies steam to the best of its ability. The quantity of water in pounds required in the accumulator for heat storage may be calculated thus:

$$W = \frac{wr}{0.65\ (t_2 - t_1)}$$

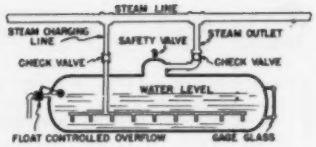
W = water in lb
w = weight of steam regenerated per time interval
r = latent heat at average accumulator pressure
t_2 and t_1 = the boiling temperatures at the higher and lower pressures in the accumulator

For example:
Assume 1500 lb of steam at 110 psia — 95 psi gage

$$W = \frac{1500 \times 883}{0.65\ (338.7 - 327.8)}$$

= Approx. 22,415 gallons of water required for the accumulator.

This is a type example. W.O.T. may calculate his requirements. This example presumes a 5 lb pressure drop. W.O.T. may be able to stand a 10 to 20 lb drop.
Mt. Vernon, Ill. ALBERT R. ECKERT



Accumulator connections

THE DRILL WENT BACKWARD— THE DRILLER ALREADY WAS!

By H. B. McDERMID

WHILE on an inspection trip around a big power house erection job, a machine erector foreman's attention was drawn to a circumstance that made him curious.

A pipe fitter was engaged in installing permanent supports for large-sized pipe that had been supported on temporary hangers. The work involved the drilling of bolt holes through members of the structural steel of the building frame. It was being done with the old-fashioned hand drilling ratchet and an "old man."

The driller was comfortably seated astride the member he was drilling, with his drill feed screwed up tight, blissfully rocking back and forth to work his drill ratchet, pausing occasionally to tighten his drill feed.

But to the foreman's amazement, he was running the drill BACKWARD!

The job was none of the foreman's business, for the workman belonged to another division. But the job looked so bad that the foreman stopped anyhow and, somewhat embarrassed, called the driller's attention to his mistake. He got this reply:

"Oh H--l, that don't make a --- ------bit of difference. I've got a reversible ratchet!"

And the driller went on plugging away as unconcerned as could be.

The foreman pulled in his neck and went on about his business, willing to let the cocky fellow suffer as much as he liked, if the dumb bunny wanted to do so, knowing he could do little harm anyhow. But he quietly noted the man several times later as he

went by. The man kept blissfully at his job, still running his drill backward, until, believe it or not, he *wore* a hole through a half-inch of structural steel with an 11/16 in. drill! He finally got his pipe hanger bolted up and actually seemed "as happy as if he had good sense."

All the foreman could think of to say was "It takes all kinds of people to make a world."

LETTERS TO THE EDITORS — *Continued from page 55*

automatic. Overload protection is then secured by protecting each feeder circuit (referring to small manufacturing plants) and installing between the bus and the alternators a reactor of suitable capacity. Many consultants do not consider it wise to dump the whole load, merely because of a feeder fault. This practice creates a great disturbance and stress on the generating unit as a whole, as well as losing the total plant load.

Not all alternators are operated with grounded systems, as outlined in the article. Nor are all protected with reverse power relays. Alternators in hydro stations can be deliberately motored, and their excitation regulated so as to control, in part, power factor on the particular loop they feed into. The alternator then becomes, in fact, a synchronous condenser. The main trouble with over or under excitation in the alternators of a generating station, is the loss of power in circulating current thru the bus and armature leads. This power loss while not registered on the board as kilowatts, is a definite loss.

The great majority of small plants have manually operated main breakers, and much care should be exercised to see that such breakers are maintained in the best condition. Breakers should be adjusted, if possible, so that each breaker has the same contact point in relation to the position of the operating handle as the other breakers. It is disconcerting, even to an experienced operator, to have a set of breakers, each of which makes contact at a different handle position. Correct phasing becomes difficult, especially when generating units are not operating correctly, or when load conditions are causing speed disturbances.
Pawling, N. Y. WILLIAM SHEFFER

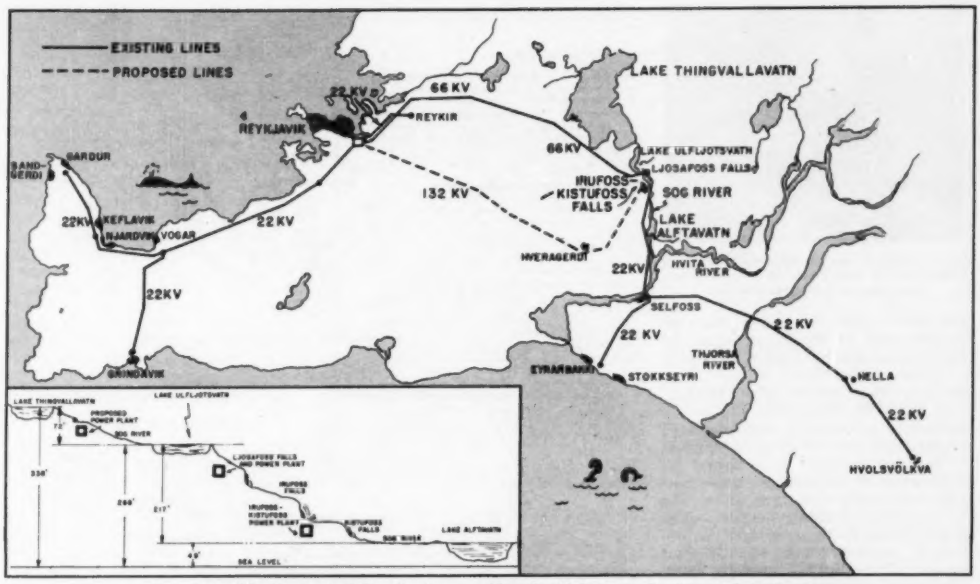


Fig. 1. Map of Southwest Iceland. Elevation diagram of River Sog Hydroelectric Development shown in inset

Iceland Builds New Hydroelectric Plants Underground

Considerable interest was aroused by the article entitled Underground Hydroelectric Plants, in the December 1950 issue of POWER ENGINEERING. To supplement that article, here is some information on new underground hydroelectric plant construction in Iceland, specially obtained from that country for POWER ENGINEERING by a Universal Trade Press Syndicate correspondent

A HYDROELECTRIC development, to produce 86,150 hp, and jointly owned by the municipality of Reykjavik and the Icelandic state, is under construction and expected to be in operation by December, 1952. The River Sog Hydroelectric Development (Sogsvirkjun) is located about 28 miles east of Reykjavik, the capital of Iceland, and is built on the Sog River between Lake Ulfljotsvatn and Lake Alftavatn. A gross head of 288 ft exists between the two lakes, of which 184 ft, concentrated in three waterfalls below Lake Ulfljotsvatn can economically be used in underground hydroelectric plants.

These include: Ljosafoss Falls which has already been developed and producing 20,150 hp; Irufoss Falls and Kistufoss Falls, the latter pair to produce 66,000 hp jointly in one power station, distributed among three hydroelectric generating units. Work on the present extension began in October, 1950 with two units planned to be installed during the first construction stage. The cost of

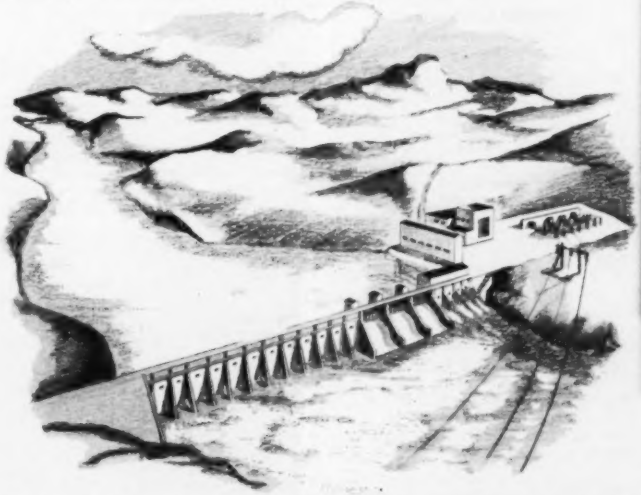


Fig. 2. Perspective drawing showing Irufoss-Kistufoss dam and surface constructions when completed. A bridge to be built above the dam is not shown

Fig. 3. View of hoisting pit leading down to Irufoss-Kistufoss powerhouse. Shows rock formations which must be blasted through

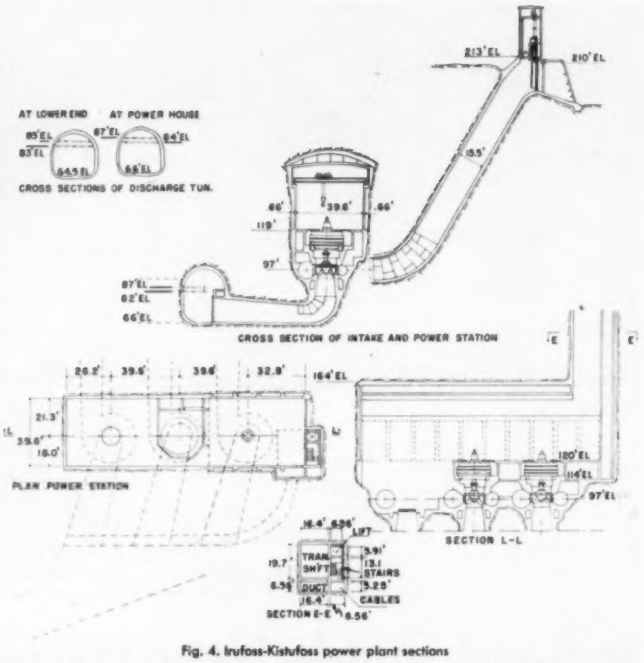


Fig. 4. Irufoss-Kistufoss power plant sections

the power plant excluding the high tension line to Reykjavik and the main transformer station is estimated to be about $6,400,000 or about $145 per rated horsepower. After the third unit has been completed, the cost is estimated to be about $120 per rated horsepower, or a total of $8,000,000.

The development is designed for utilization of 5300 cfs of water distributed among the three units. The intake dam, including bottom outlet and spillway sections, is built of reinforced concrete and erected just above Irufoss. The western bank abutment, however, will be constructed as an earth dam with a tightening core of reinforced concrete. The water intake for the power station with trash-racks and by-pass for ice is located close to the dam on the eastern bank. From the intake will be blasted three slanting tunnels with reinforced concrete and plate steel pipe linings leading down to the turbines.

Access to the power station is arranged through a vertical shaft with an open hoisting pit and crane for handling the machinery. In order to obtain information on the rock condition and whether linings would be necessary, several test drillings and blastings were made. The construction work is being done by the Foesskraft firm in Reykjavik. The turbines are purchased from the Karlstads Mekaniska Werkstad firm in Sweden and the generators, transformers and other electrical equipment from Westinghouse Electric Corp., U. S. A.

SUPERSONIC-RADIOGRAPHIC INSPECTION

By HERBERT R. ISENBERGER
St. John X-Ray Laboratory
Clifton, New Jersey

MUCH HAS BEEN written in recent years about supersonic testing[1], so that the readers of this Journal are acquainted with this method as well as with radiographic inspection[2]. Both methods have their advantages and shortcomings. Supersonic testing is faster and cheaper than radiography, but its results are not as reliable. Applied together, they tend to give as nearly perfect results as can be expected. This may be best shown on hand of some actual experience.

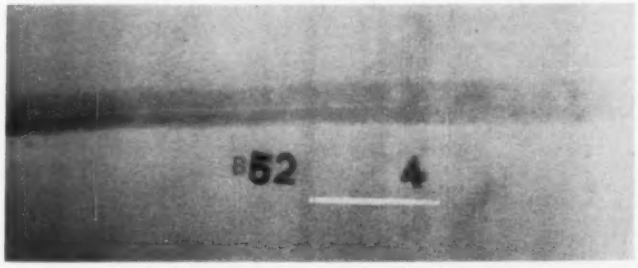
The problem was the examination of some 650 linear feet of butt-welding, longitudinal and girth seams, in 16 pressure containers, about 9 ft long with an outside diameter of 7 ft 6 in. The wall thickness was ¼ in. low carbon steel. All welds were tested by the supersonic method, and the results were marked on blueprints for each container.

Upon completion of the supersonic inspection, the most defective portions of the welds were singled out for radiographic check. Altogether about 10 per cent of the welded seams had to be radiographed.

Of this amount about 20 per cent showed a continuous lack of fusion throughout the length of the film (10 inches), whereas supersonic indicated the longest continuous defect to be but 3 inches. A typical illustration of this is shown herewith where the supersonic picked out a 2-in. section between 52½ and 54½, but the defect is clearly visible for the full 10 in. of the film.

On the other hand, in about 10 per cent of the radiographed portions where the supersonic inspection indicated serious voids, no defects or only minor ones showed up.

Thus it appears proper to check any large irregularity showing on the reflectoscope screen by a radiographic exposure, in order to make sure that (1) a serious defect exists, and (2) what kind of defect it is.



Radiographic record of longitudinal seam showing defect the full 10-in. of the film but where the supersonic picked out only a 2-in. section between 52½ and 54½ in.

[1] Benson Carlin, Testing Welds with Supersonic Waves. *The Welding Journal*, Vol. 27, June 1948, p. 438–40.
[2] St. John and Isenberger, Industrial Radiology. John Wiley & Sons, New York, 2nd Edition, 1943.

(*Continued from page 61*)

former is connected through a 138 kv, 3500-kva oil circuit breaker to the 138-kv bus.

Excitation System

Each generator is excited by a 220-kw, 250-v exciter which is directly coupled to the generator shaft. This exciter in turn is excited by a 4.4-kw, 250-v pilot exciter, which is also directly driven by the shaft. The exciter leads are connected to the generator field through a DPST electrically operated, non-automatic, air circuit breaker. The generator voltage is controlled by an indirect acting, exciter-field-rheostatic-type voltage regulator. This regulator operates the motor driven exciter field rheostat.

Station Auxiliaries

Each generating unit is provided with a 3150-v and a 400-v station auxiliary bus. The 3150-v bus derives its power directly from the generator through the 5000/6250-kva, 13,200/3150-v transformer. The 400-v bus in turn derives its power from the 3150-v bus through the 1250-kva, 3000/400 v transformer. These two unit busses serve all the auxiliaries for their respective generator units.

In addition to the normal auxiliary supply there is a 5000/6250-kva, 138,000/3150-v reserve transformer which is connected directly to a breaker on the 138-kv bus. This transformer is connected to the reserve 3150-v bus. This reserve bus supplies power to the station essential auxiliaries such as coal handling, ash handling, fire pumps, etc. In addition, this bus provides standby and starting-up power to each 3150-v unit auxiliary bus and serves the 1250 kva, 3000/400-v reserve transformer. This reserve transformer, in turn, supplies 400-v power to the station essential auxiliaries and standby power for each 400-v unit bus. If loss of voltage occurs on any one of the unit 3150-v busses, the load is automatically transferred to the reserve bus.

All of the auxiliaries of this plant are electrical. The larger essential motors, 200-hp and above, are 3000 v and each is connected to an individual electrically operated air circuit breaker on the 3150-v bus. All other motors ½-hp to 200 hp are 380 v. The larger of these 380-v motors are connected to individual electrically operated air circuit breakers on the 400-v bus. The smaller 380-v motors are served from the 400-v bus in groups, each group making up a motor control center.

The coal handling system motors are all 380-v and are served from a double ended, 1500-kva, 3000/400-v unit substation.

Transformers

Each 65,000-kva generator transformer is provided with two 2½ per cent rated kva taps above and below normal high voltage with a manual no-load tap changer. These transformers are located in the outdoor substation. The three unit 3150-v station service transformers are located outside the West building wall.

ELECTRICAL EQUIPMENT AT BOKARO STATION

Main power transformers, 3—General Electric Co. Three-phase, 65,000 KVA, forced-oil water cooled, two winding type, 138 KV grounded wye, 13.2 KV delta, 50 cycles, outdoor.

Station service reserve transformer, 1—General Electric Co. Three-phase, 5000/6250 KVA, self-cooled/forced air cooled, two winding type, 132 KV delta—3.15 KV wye, 50 cycles, outdoor.

Station service transformers, 3—General Electric Co. Three-phase, 5000/6250 KVA, self-cooled/forced air cooled, two winding type, 13.2 KV delta—3.15 delta, 50 cycle, outdoor.

Station service transformers, 4—General Electric Co. Three-phase, 1250 KVA, pyranol, self-cooled, two winding type, 3150 V delta—400Y/230V grounded wye, 50 cycle, indoor.

Oil circuit breakers, 11—General Electric Co. Outdoor type, 138 KV, 1200 amp, 3500 mva. interrupting capacity, pneumatically operated, 5 cycle interruption, 20 cycle reclosure, 3-pole.

Disconnecting switches, 34—General Electric Co. Horn gapped, electrically operated, outdoor air type, 161 KV, 600-amp, triple pole single throw.

Outdoor Substation, 1—General Electric Co.

Metal clad switchgear, Indoor, 4—General Electric Co. 3150 V, 3-phase, 50 cycle, equipped with magne-blast type circuit breakers rated at 3000 V, 1200-amp. and with a 150,000 KVA interrupting capacity.

Metal enclosed switchgear, 4—General Electric Co. Deadfront, draw-out ACB type, 600 V, 2000-amp and 600 amp., 3-phase, 4-wire, 50 cycle.

Duplex control switchboard, 1—General Electric Co.

Station service switchgear, 28—General Electric Co. 400Y/230-V, grounded wye cubicle type.

Storage battery control cubicle, 1—General Electric Co.

Generator excitation switchgear, 3—General Electric Co.

Generator surge protective equipment, 3—General Electric Co.

Coal handling load center, 1—General Electric Co.

Generator bus and ground equipment, 3—General Electric Co. Isolated phase bus duct and distribution transformer type neutral grounding with resistor.

Storage battery, 1—General Electric Co. 250-V, 800-amp-hour (8 hour basis).

Battery charging m-g sets, 2—Electric Products Co.

Automatic telephone system, 1—India

Inter-communication system, 3—Gai-Tronic Corp.

Fire alarm system, 1—Auto-Call Co.

Annunciators, 3—Auto-Call Co.

138-KV Outdoor Substation

The 138-kv outdoor substation is located on the West side of the power house and is remotely controlled from the duplex switchboard. A main and transfer bus arrangement is provided. The main bus is sectionalized through motor operated disconnecting switches so that one section of bus can be removed from service for maintenance and repair. A bus tie breaker is provided. Any line breaker may be taken out of service for routine maintenance or repair and replaced by this bus tie breaker.

Each breaker is provided with motor-operated isolating disconnect switches. Each line breaker is also provided with a motor-operated breaker by-pass disconnect switch, which connects the line to the transfer bus. Each generator breaker and the reserve transformer breaker are also provided with a motor operated disconnect switch which connects the breaker to the transfer bus. The motor operated disconnects are interlocked with their respective breakers to insure proper operation.

The two 138-kv buses and cross buses are supported by overhead steel structures using strain buses. All buses and switches are kept close to the ground to facilitate inspection and maintenance. Ground wires are extended overhead, over the main buses to provide for lightning protection. Three station type lightning arrestors are also connected to each outgoing line.

All the 138-kv breakers are oil insulated and have pneumatically operated mechanisms. Each breaker is equipped with six (6) standard bushing current transformers for relaying. In addition, each feeder breaker has two (2) additional metering accuracy bushing current transformers for metering and one (1) bushing potential device for synchronizing.

For relaying and metering three (3) single phase potential transformers, rated 500 volt ampere, 138,000/80,-500 — 67/115-v are connected to each section of the 138-kv main bus. The operation of this outdoor substation is controlled from the duplex switchboard in the electrical control room.

Relay Protection

A separate differential protective scheme is used for the generator, main step-up transformers, and the 3150-v station service transformers. With this method high speed tripping and selectivity is insured. The generator is protected by high speed product restraint differential relays. For backup protection voltage restraint over-current relays, which trip only on a high current and low voltage, are used. The main step-up transformer banks and the 3150-v station service transformers are protected by harmonic current restraint percentage differential relays. The two types of restraint present in these relays prevents tripping on magnetizing inrush current and heavy through currents. For backup protection of the transformers, inverse time induction overcurrent relays are provided. The 138-kv outdoor substation bus is protected by high speed differential voltage relays which operate in from two to three cycles. Each 138 KV feeder is protected against phase to phase and three phase faults by directional distance impedance relays, and against phase to ground faults by directional ground relays.

The 3000-v motors are provided with thermal relays for indicating an overload on an annunciator and short circuit protective relays for tripping

(*Continued on page 110*)

New ENGINEERING BOOKS

Essentials in Problem Solving, by Zuce Kogan; 80 pages; size 5 by 8 in.; cloth bound; published by Zuce Kogan, 724 Sheridan Road, Chicago 13, Illinois. $3.00

Here is an unusual and thought-provoking book — especially so for engineers. The author is himself a successful consulting engineer, with long experience in solving engineering and business problems for his clients. All engineers are primarily problem-solvers, with their own individual methods of attacking problems. Mr. Kogan has attempted in his own thinking to determine whether or not any general principles of problem-solving exist and to set them down in this book.

He shows how simple procedures expressed in terms of general principles helped him solve very difficult problems. He shows how these procedures can be used in various fields of science, engineering, business — in fact, in all human affairs.

In summary, the essential in problem-solving is: If you do not have a specific solution to a specific problem, then generalize the problem and attempt to match it with a general solution, principle or approach. The author discusses personal factors, scope factors and look-further factors; processing the problem; and various implications of the application of problem-solving principles.

The importance of Mr. Kogan's discussion is not in telling the reader many things he does not know, but rather in leading him to attempt development of fundamental principles from things he already does know. Every engineer at one time or another uses one or more, or perhaps all, of the specific methods of problem solving. He often knows how others have solved similar problems. He remembers or has records of how he has solved previous problems. But when new problems arise, he usually concentrates on the detailed procedures rather than on the fundamental principles.

Mr. Kogan shows him how dependence on such fundamental principles will enable him to find fast answers to problems, like pulling rabbits out of a hat. This is the way all the world's great thinkers, in every field, have handled problems.

What could be more "practical" than a book that, by making you think, helps you to get better, faster solutions to your everyday problems? That's what this book does.

Instrumentation for the Process Industries — Proceedings of the Fifth Annual Symposium on Instrumentation for the Process Industries, 1950, conducted by the Department of Chemical Engineering, Agricultural and Mechanical College of Texas; 64 pages; illustrated; 8½ by 11¼ in.; paper bound; published by Instruments Publishing Co., Pittsburgh 12, Pa.; 1951; price $2.50 postpaid.

If printed in regular textbook size and in textbook-size type instead of the rather small type, this would be a volume of about 200 pages. On a basis of wordage, therefore, it is well worth $2.50.

There are ten papers, on subjects ranging from laboratory automatic analyzers to power-plant automatic control. The broadest subject is Economics of Instruments by John Lynch, President of La Gloria Corp. Several papers are rather narrow but will appeal to instrument specialists. A most informative feature is the verbatim report of the Questions and Answers periods.

Obituaries

WILLIAM A. CORYEA

WILLIAM A. CORYEA, a project manager of The Rust Engineering Co., died at his home, in Mt. Lebanon, near Pittsburgh, Penn., on August 13 after an illness of many months. Aged 58, he was considered a national authority on paper mill and on power plant design and construction for the steel and other industries.

He first joined the Rust organization at its Birmingham, Alabama, office in 1928. In 1936 he moved to the Pittsburgh office. In his 23 years with the company, he became one of its leading engineers, taking part in the design of many of the major paper mills and power plants now operating both in this country and abroad.

WILLIAM C. JOHNSON

WILLIAM C. JOHNSON, executive vice president of Allis-Chalmers Manufacturing Co., died July 26. He was a member of the firm's board of directors and also a member of the executive committee of the board. In addition, Johnson served as chairman of the board of Canadian Allis-Chalmers (1951) Ltd.

Johnson was born in Birmingham, Alabama, on May 25, 1902, the son of E. Judson Johnson and Ida *nee* Hollingsworth Johnson. He attended grade school and high school in Birmingham and began his career in the electrical industry in 1920 as an apprentice for the Alabama Power Co.

EDWARD L. MORELAND

EDWARD L. MORELAND, '07, retired Executive Vice-president of the Massachusetts Institute of Technology, died at West Falmouth, Mass., on June 17, at the age of 65.

Dr. Moreland was a native of Lexington, Va., and was educated at Johns Hopkins University and M.I.T. In addition to his association with the Institute, he was for many years a member of the engineering firm of Jackson and Moreland. During the years of his devoted service to the Institute from 1935, when he became head of the Department of Electrical Engineering, until his retirement as executive vice-president of the Institute in 1950, Dr. Moreland's wide experience in engineering and his characteristic thoroughness and well-considered judgment were of enormous value to Technology in almost every phase of its administration. Having served as head of the Department of Electrical Engineering from 1935 to 1938, Dr. Moreland was then appointed dean of engineering and held that post until his appointment as executive vice-president in 1946.

WILLIAM E. HERB

THE death of William E. Herb, aged sixty-one, Vice-President and General Sales Manager of Gifford-Wood Co., occurred suddenly Tuesday evening July 3, at the Columbia Memorial Hospital, Hudson, N. Y., following several days of illness of a critical heart ailment.

Mr. Herb, a graduate of Lafayette College, joined Gifford-Wood Co., at Hudson, N. Y., in July 1916. In 1925 he became District Sales Manager of the company's Pittsburgh branch office.

In 1929, he was appointed Sales Manager of their Eastern Division with headquarters in the Graybar Building, New York City.

On January 1, 1947, he became General Sales Manager of the company. He was elected Vice-President in March of this year.

NEWS from THE FIELD

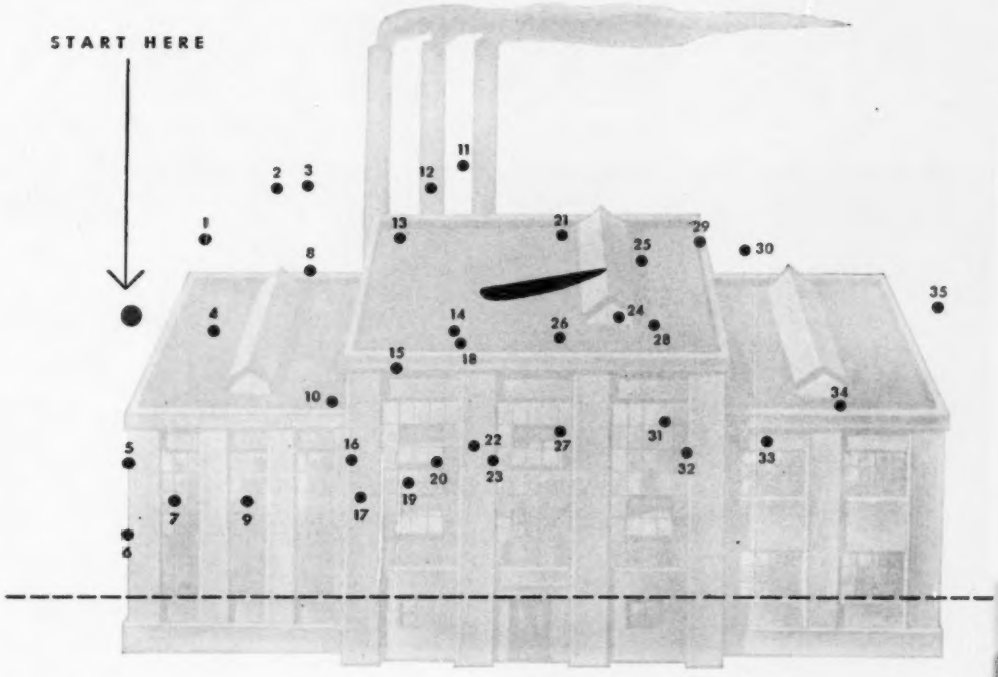
PUBLICATION of *Air Repair*, a magazine devoted to the problems of air purification, is announced. The new magazine is the official publication of the Air Pollution and Smoke Prevention Association of America, a 44-year-old organization which moved its headquarters from Chicago to Pittsburgh last winter. Its offices are now located in Mellon Institute. Editor of *Air Repair* is Robert T. Griebling, a Fellow of Mellon Institute and Executive Secretary of the Association.

The first issue covers, in detail, the Association's Annual Convention held in Roanoke, Virginia, and devotes most of its 16 pages and photographs to a report on the papers read at the Convention and articles on the officers elected for the coming year. At present four issues a year are contemplated, but as the Association grows it is planned to publish the magazine monthly.

R. J. S. PIGOTT NOMINATED FOR 1952 ASME PRESIDENT

REGINALD J. S. PIGOTT, director of the engineering division of Gulf Research & Development Co. of Pittsburgh, a subsidiary of Gulf Oil Corp., has been nominated as 1952 president of The American Society of Mechanical Engineers. Mr. Pigott heads a slate of new ASME nominees.

(Continued on page 97)



This puzzle may solve a plant puzzle for you!

This is The BETZ INDICATOR, a monthly publication devoted to general discussion of all water problems. It's free. Write.

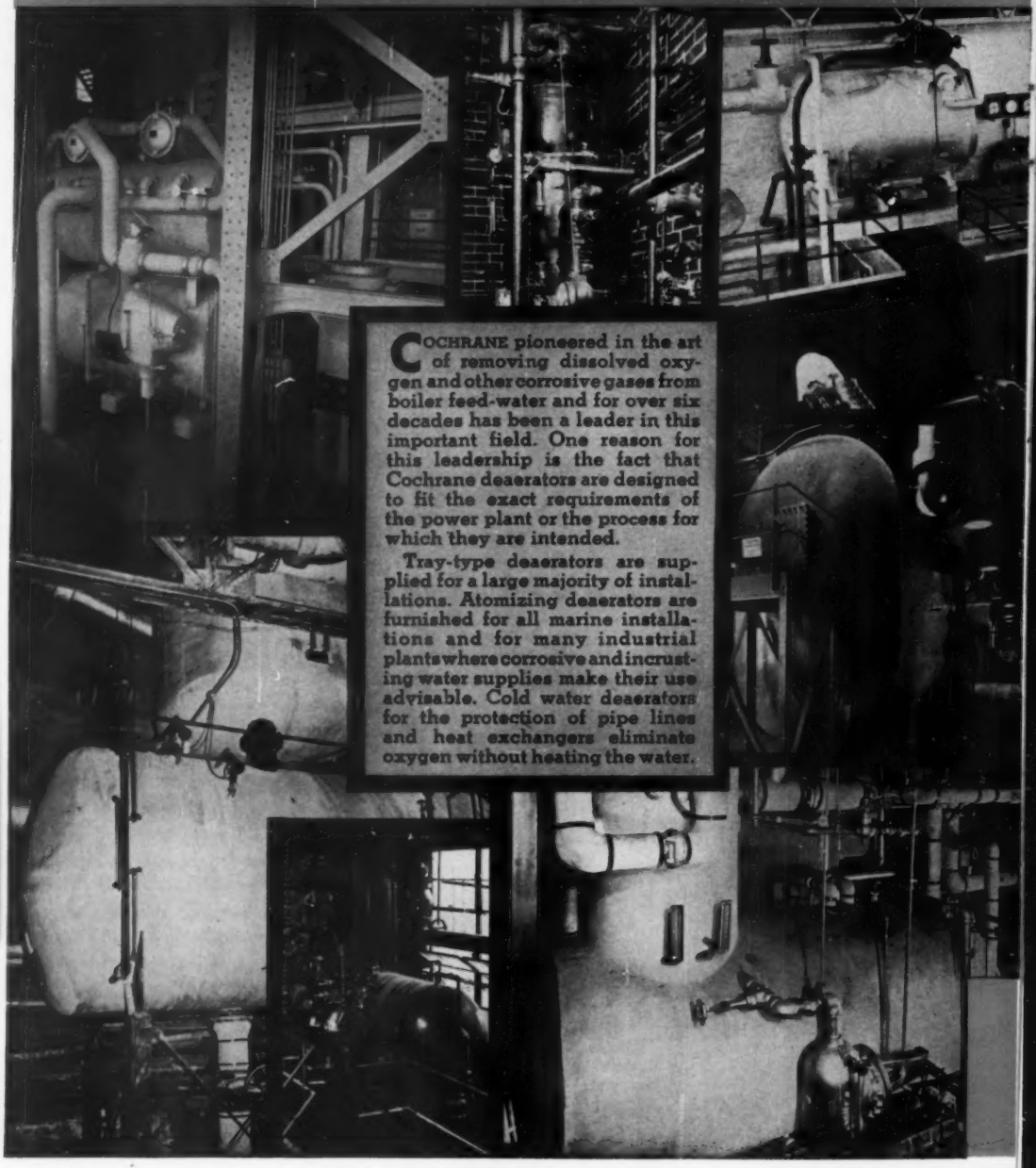
Water for industrial use can . . . and usually does . . . pose an infinite variety of unidentical problems. Variables include the water itself, the plant equipment, the operating conditions and a host of other factors. The proper approach to the solution of a water treatment problem . . . however puzzling . . . is to engage specialists who provide an adequate and well-balanced program of scientific control.

BETZ is a nationwide service organization specializing in the solution of all water problems. We offer a complete water conditioning service that is scientifically correct—designed to help you maintain all-out production. If the results you are presently obtaining are not entirely satisfactory, let us explain how our specialized service can help you. W. H. & L. D. BETZ, Gillingham & Worth Streets, Philadelphia 24, Penna. In Canada: BETZ Laboratories Limited, Montreal, 1.

BETZ

BOILER WATER CONDITIONING • COOLING WATER CONDITIONING • INDUSTRIAL WASTE TREATMENT

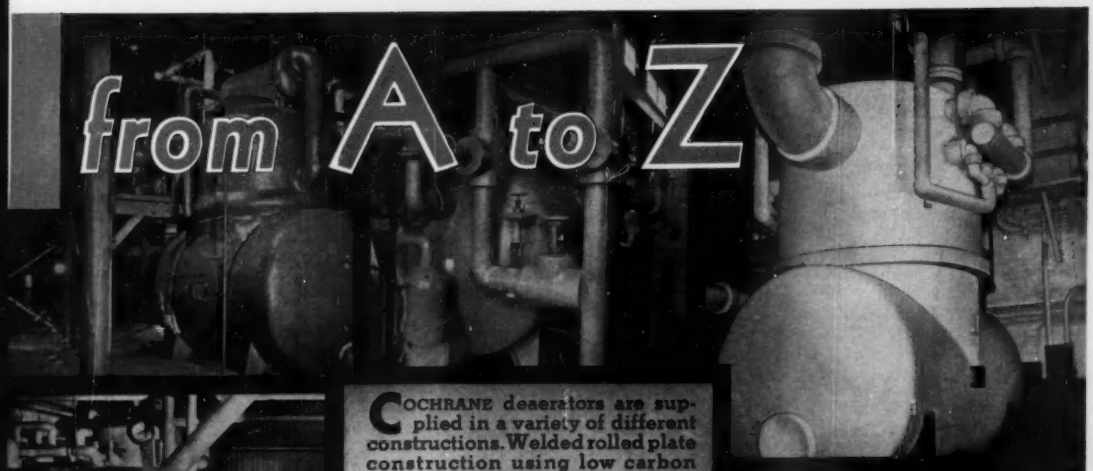
DEAERATION

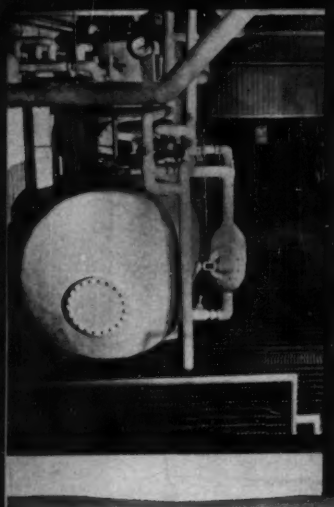


COCHRANE pioneered in the art of removing dissolved oxygen and other corrosive gases from boiler feed-water and for over six decades has been a leader in this important field. One reason for this leadership is the fact that Cochrane deaerators are designed to fit the exact requirements of the power plant or the process for which they are intended.

Tray-type deaerators are supplied for a large majority of installations. Atomizing deaerators are furnished for all marine installations and for many industrial plants where corrosive and incrusting water supplies make their use advisable. Cold water deaerators for the protection of pipe lines and heat exchangers eliminate oxygen without heating the water.

from A to Z

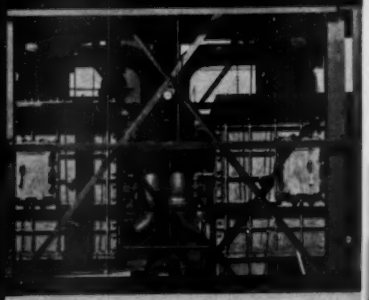


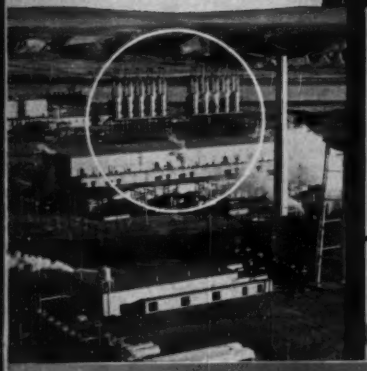


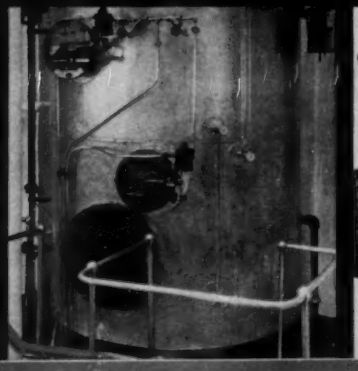
COCHRANE deaerators are supplied in a variety of different constructions. Welded rolled plate construction using low carbon steel, alloy steels and other metals is furnished for all pressures and capacities. Cast-iron shells of heavy, deeply-ridged sectional plates, with caulked joints, may also be supplied.

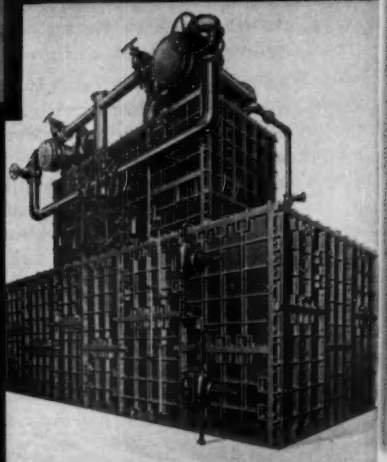
Special designs to meet unusual conditions, such as space limitations, are often necessary and Cochrane's long experience in this field invariably results in considerable savings in the cost of the power plant by obviating changes in building construction or in the arrangement of the equipment. Installations shown on these two pages are typical. Write for details.

COCHRANE CORPORATION
Philadelphia 32, Pennsylvania









COCHRANE

ASSURED SUPPLY OF HIGHEST QUALITY BOILER FEED WATER—WITHOUT EVAPORATION

Raw water analyses often vary widely—from season to season and even from day to day. So may the demand for treated water in a modern power plant. AMBERLITE Ion Exchange Resins quickly solve both problems—give you the water you want from the water you have—*without the use of evaporators.*

An adequate supply of highest quality, conditioned water is assured with AMBERLITE Ion Exchange Resins. Even when dissolved solids in the raw water are at a high level and peak output is required, ion concentration of the treated water can be maintained at 0.1 p.p.m. or less. Silica, carbon dioxide and hardness are almost completely eliminated, often in *one* pass through *one* exchange column.

For details about low-cost, *silica-removing deionization*, send for our bulletin on AMBERLITE Ion Exchange Resins. Then discuss the AMBERLITE process with your consulting engineer or water conditioning equipment supplier. He'll be glad to help you choose the multiple-bed installation or Monobed unit that suits your specific needs.

Newest Word in Water-Treating

MONOBED DEIONIZATION

One pass through one column of AMBERLITE mixed anion and cation exchange resins can transform raw water into deionized, silica-free water. Ask for our 12-page booklet, "Monobed Deionization."

AMBERLITE is a trade-mark, Reg. U. S. Pat. Off. and in principal foreign countries.

CHEMICALS FOR INDUSTRY

ROHM & HAAS COMPANY

THE RESINOUS PRODUCTS DIVISION

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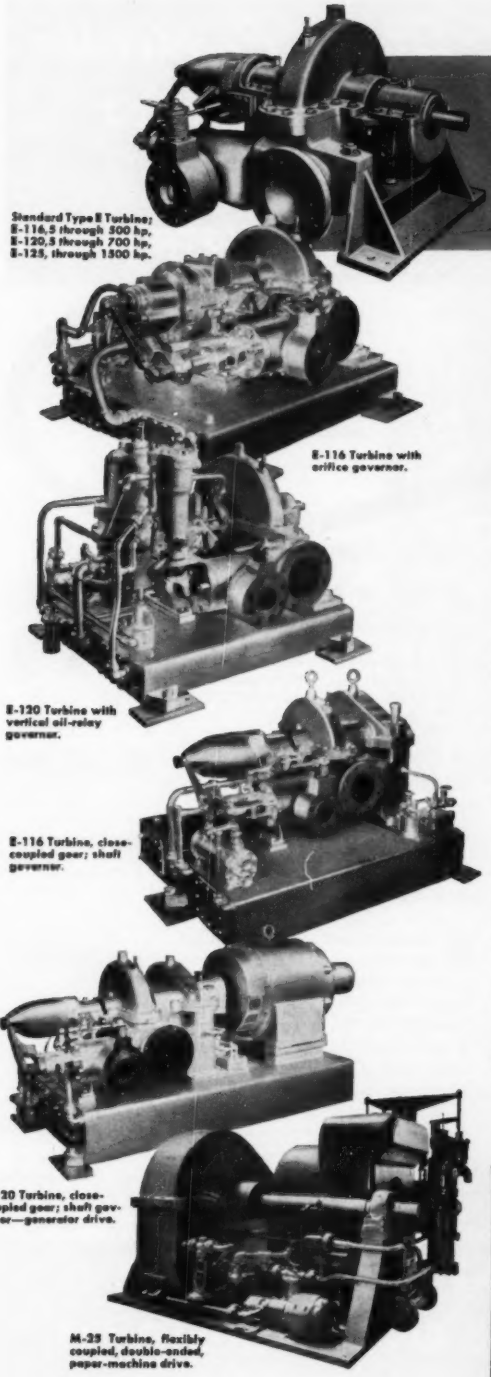
Take the *Guesswork* out of Turbine Selection!



Standard Type E Turbine; E-116.5 through 500 hp, E-120.5 through 700 hp, E-125, through 1500 hp.

E-116 Turbine with orifice governor.

E-120 Turbine with vertical oil-relay governor.

E-116 Turbine, close-coupled gear; shaft governor.

E-120 Turbine, close-coupled gear; shaft governor—generator drive.

M-25 Turbine, flexibly coupled, double-ended, paper-machine drive.

Westinghouse General-Purpose Turbines can be supplied for mechanical or generator drive . . . either direct connected or geared . . . for condensing or noncondensing operation. This *complete* line . . . plus a nationwide staff of trained steam engineers, conveniently located sales offices, and service shops . . . assures you of the correct solution to *your* steam-drive application problem.

The single-stage Type E turbine, with designs for three basic classes of steam conditions, three wheel sizes and three standard governor types, provides in effect twenty-seven *standard, economical* variations to cover a wide range of applications. In addition, an almost limitless number of special applications can be met through the use of heavy-duty parts, and optional accessories.

Geared-turbine drives are offered either flexibly coupled to accommodate either right- or left-hand gear offsets, double-ended output shafts; or close-coupled (Gearturbines). Gearturbines are standardized on a single offset arrangement, affording utmost economy.

Other types in the complete Westinghouse general-purpose turbine line include heavy-duty and multi-stage units for applications requiring high temperatures and pressures, higher speeds, greater horsepower, extraction for process applications, or higher efficiency than may be had with single-stage machines.

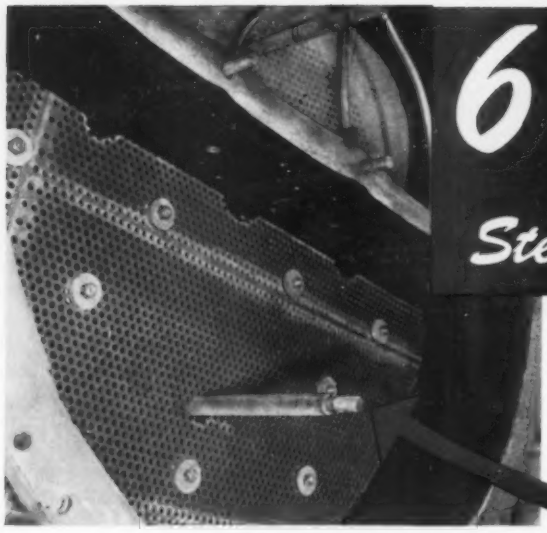
The superiority of the Westinghouse line is the result of over 60-years' design, manufacture, and application experience. To get the benefit of this broad know-how, call your nearby Westinghouse office, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.

J-50532

YOU CAN BE SURE... IF IT'S

Westinghouse

GENERAL-PURPOSE TURBINES



6 Steam Condenser Specialties THAT ASSURE Steady Performance

Air erosion eliminator installed on C-3 Cargo vessel. Perforated baffle plates in first condenser pass with collecting tubes and manifold are shown.

Which of These Useful First-Aid Items Does Your Plant Need?

Described below are seven steam condenser specialties developed by Conseco engineers to simplify maintenance and step up performance.

1 *Wizard Injector* • Condenser tubes are subject to corrosion and erosion which may develop small leaks in the tube walls. To plug these leaks while the condenser is in operation, Conseco has produced the Wizard Injector. Operated by steam, this device introduces a special compound into the inlet circulating water which seals the leaks; avoids shutdowns between normal inspection and cleaning periods.

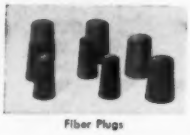
Wizard Injector

2 *Air Erosion Eliminators* • This simple apparatus, perfected by Conseco, completely liberates air from water before it enters the tube. It consists of perforated plates which induce turbulence in water as it passes through perforations; may be fitted in condensers having one, two or more passes.

3 *Flowrites* • In installations where it is impractical to fit an Air Erosion Eliminator, air erosion of the tube inlets can be combated by the use of Flowrites, sometimes called "inserts" or "wearing sleeves." They serve as replaceable wearing sections; are fitted to the inlet ends of tubes for distances depending on length of attacked tube section.

Flowrites of various sizes

4 *Plugs for Condenser Tubes* • Use of right plugs will help keep condensers going until there is time for a complete overhaul. Conseco engineers have developed plugs of machined fiber which give full satisfaction. They are installed with light hammertap.



Fiber Plugs

5 *Detect-A-Leak* • To simplify tube testing, Conseco offers the Detect-A-Leak. It consists of a solid rubber plug for one end of tube, hollow rubber plug for opposite end. Leak in tube wall collapses rubber nipple on hollow plug. These dependable test kits available from stock in all standard sizes.

Detect-A-Leak

6 *Conco Gun* • For cleaning inside tube surfaces of slime, algae or soft scale deposits Conseco recommends the hydraulically operated Conco Gun and Plug. Trigger releases a jet of water which forces a metal spring leaf plug through the tube. Plugs come in all standard tube sizes.

Conco Gun and Plugs

Items 1, 4, 5 & 6 in stock for all standard tube sizes. Items 2 & 3 *MADE TO ORDER FOR QUICK DELIVERY*, raw material held in stock.

WRITE FOR BULLETINS—It will pay you to get further information about these first-aids to continuous condenser operation. Check items of interest and we will send descriptive bulletins.

CONSECO

CONDENSER SERVICE & ENGINEERING CO.

HOBOKEN, NEW JERSEY

NEWS FROM THE FIELD

(*Continued from page 90*)

Director of engineering research of Gulf Research & Development Company since 1929, Mr. Pigott's professional record is a long and distinguished one.

Mr. Pigott holds more than 30 patents on devices used in hydraulic engineering, heating, oil production, and instruments. He has written more than 40 technical papers on power station design, fluid flow, instruments, vapor lock, lubrication, super-chargers, and aviation fuel and lubrication systems published in technical and trade magazines (including *Power Plant Engineering*, now POWER ENGINEERING), in the proceedings of numerous technical societies, and in scientific handbooks. He has rendered extensive service as consulting engineer, as expert in patent litigation, and as designer of power and industrial plant projects.

Mr. Pigott was born at Wellington, Shropshire, England, Feb. 4, 1886. He attended public schools in New York, was graduated from DeWitt Clinton High School in 1902 and received a mechanical engineering degree from Columbia University in 1906. He received the University Medal in 1946.

He has been associated with Interborough Rapid Transit Co.; New England Engineering Co.; Remington Arms-Union Metallic Cartridge Co.; Crosby Steam Gage & Valve Co.; Gradon Manufacturing Co.; Stevens & Wood, Inc., and others.

He became a junior member of The American Society of Mechanical Engineers in 1912, an associate member in 1913, a member in 1918, and was made a fellow of the society in 1938. He served as a vice president of ASME from 1936–1938. He was chairman of the ASME Special Research Committee on Fluid Meters from 1916–1946 and was responsible for starting this committee; and was a member of the main Power Test Codes Committee and chairman of the Definitions and Values Committee from 1918–1946. He was president of ISA in 1950. He is a member of Theta Xi and of Tau Beta Pi, Sigma Tau and Sigma Xi honorary fraternities.

Regional vice presidents nominated are:

Willis Frederick Thompson, chief mechanical engineer, Westcott & Mapes, Inc., New Haven, Connecticut.

Ernest Henry Hanhart, consulting mechanical engineer, Baltimore, Md.

Ernest Stephen Theiss, assistant chief engineer, Davey Compressor Co., Kent, Ohio.

Samuel H. Graf (renomination), director, Engineering Experimental Station, Oregon State College, Corvallis, Ore.

Nominated as directors-at-large:

Albert Carl Pasini, superintendent, production department, The Detroit

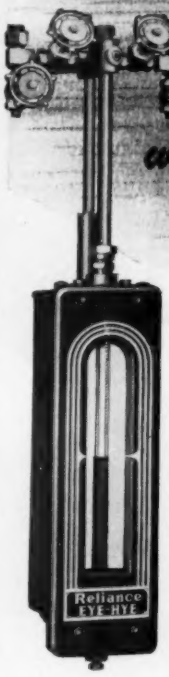
(*Continued on page 118*)

For full assurance of safe, accurate boiler water level reading

wherever you want it...

RELIANCE

Remote Reading EYE-HYE



Why it pays you to install EYE-HYE

Flexibility of Placement. Gage reading *precisely where* most convenient to see — even *above* the boiler, if power plant arrangement indicates.

Easy, *Natural* Reading. Indication by column of liquid like the familiar conventional boiler water gage.

Sharp Visibility. Eye-appealing green indicating fluid, illuminated to provide a sharp mistake-proof image.

Scientific Accuracy. Relies on the positive law of physics embodied in the U-tube manometer principle.

Simplicity. Smooth hydrostatic action—no mechanical working parts—no adjustments on location.

Safety. Invites frequent reading—an aid to preventing water level accidents.

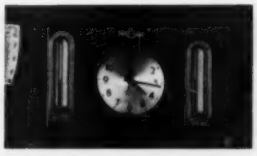
Easy Installation. Copper or steel tubing follows most convenient path from temperature equalizing unit at drum to desirable gage window location.

Low Maintenance. Scheduled cleaning only at infrequent intervals. Easy to blow down to insure clean lines.

Write for complete catalog information covering the many uses of EYE-HYE.

Besides the EYE-HYE Reliance makes a complete line of Water Columns, Water Gages and other trim for all working steam pressures.

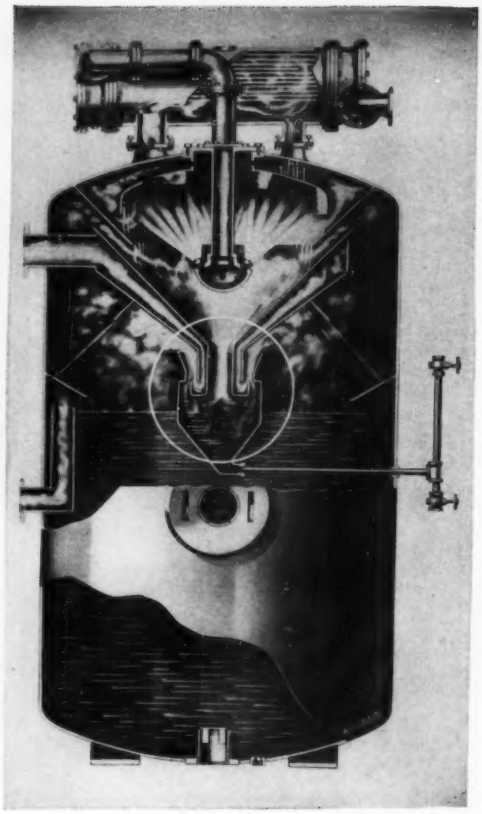
THE RELIANCE GAUGE COLUMN COMPANY, 5902 Carnegie Ave. Cleveland 3, Ohio



The name that introduced safety water columns....in 1884

Reliance®

BOILER SAFETY DEVICES



Hard scale, formed on the trays of deaerating evaporator preheaters, is no longer the big problem it used to be.

In a large central station (name on request), the preheaters had to be cleaned every three weeks, and the units were completely shut down at that time from eight to ten hours.

Then Worthington steam-jet deaerators were installed—with a "blowdown" head designed by Worthington engineers. This special head allows the operator to remove harmful deposits at regular intervals *while the unit continues in service*. It also provides for simple and speedy acid cleaning of critical parts, when necessary, without even opening an access door or removing any parts from the unit.

Compare The "Time-Outs"

The Worthington unit, given a short blowdown once each shift, stays in continuous operation with maximum deaeration for periods of at least 8 months. When the acid treatment is given at the end of that period, the job is finished in under three hours.

Compare this with the former record. *Then*—8 to 10 hours outage every three weeks and labor by a *crew* of men. Now—with Worthington's blowdown head—operation uninterrupted during regular short blowdown, with a shutdown for acid cleaning only once in almost a year, requiring only one man and three hours!

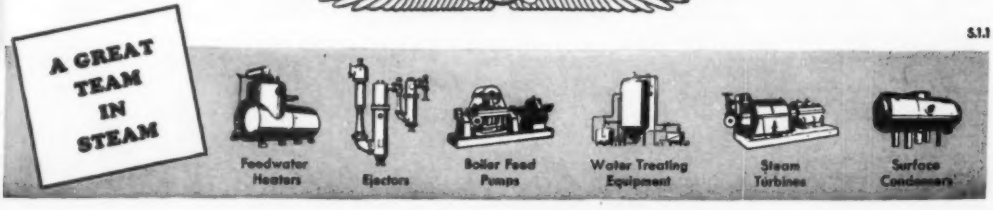
Worthington Makes Deaerating Equipment News

Developments like this, applicable to any deaerators operating under conditions of scaling, are typical of Worthington's engineering firsts in water treating and deaerating equipment.

Worthington manufactures all of the equipment needed in a complete water treating installation. For further information on why *there's more worth in Worthington*, address Worthington Pump and Machinery Corporation, Steam Power Div., Harrison, N. J.

WORTHINGTON

S.1.1



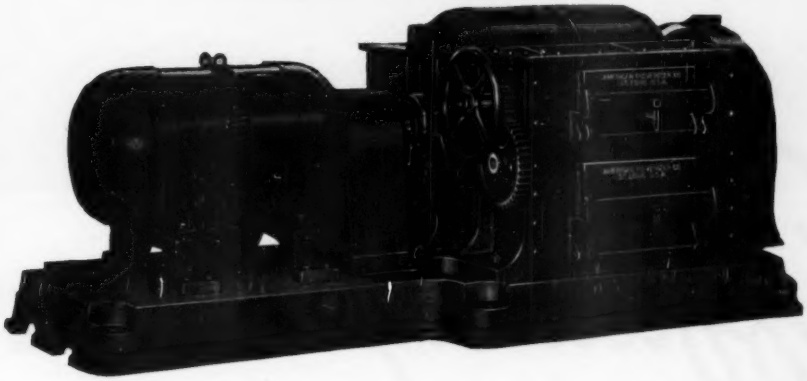
CASE HISTORY

"CRUSHING" FACTS on American Crusher PERFORMANCE

(Taken From An Independent Survey)

AC-7-C REDUCES 12" ROM COAL TO MINUS 1"—AT 550 TPH

"Operating at 10% Beyond Rated Capacity . . .
10% Under Power Capacity"



Here's the whole production story on this American AC-7-C, installed in a South Carolina Power Plant . . . reducing 12" ROM lumps to —1" at 50 tons per hour in excess of the factory-rated capacity —and doing it on only 90% of the potential motor load!

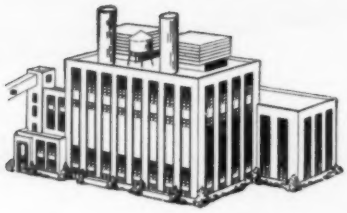
Once again, the efficient American-originated Shredder Ring Crusher has proved its ability to produce more on lower power needs.

Why not let us tell you the full story? Write for literature today.

American PULVERIZER COMPANY

Originators and Manufacturers of Ring Crushers and Pulverizers

1431 MACKLIND AVE. **ST. LOUIS 10, MO.**



● at the New GADSDEN

Steam Plant of the

Alabama Power Company

Efficiency HAS BEEN

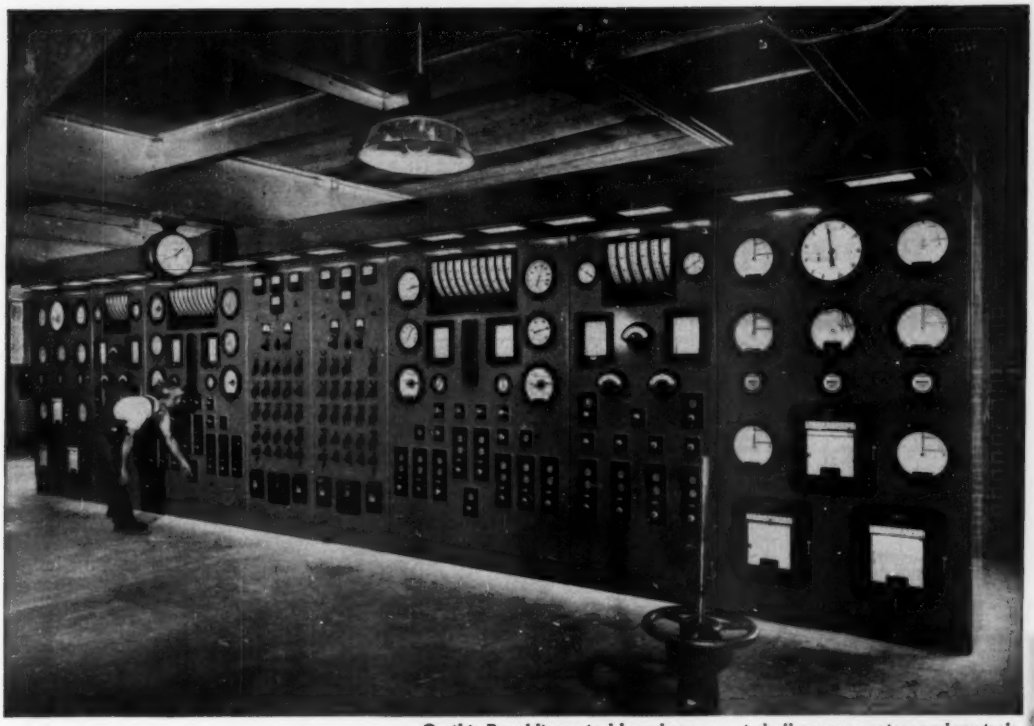
Three of the coal feeders and Republic regulators serving one of the boiler units.

It is the policy of Alabama Power Company to generate, transmit and distribute electricity to its customers at the lowest cost consistent with good service.

When designing the new 120,000 kw. Gadsden Steam Plant, the Alabama Power Company, in keeping with this policy, incorporated proven engineering developments which contribute to economical power generation. High among these was REPUBLIC automatic boiler control.

Two steam generators, each with a capacity of 600,000 pounds of steam per hour, and operated at 875 psig. and 885°F, supply steam to the two turbines. Fuels used are natural gas or pulverized coal, either singly, or in combinations.

The REPUBLIC control board is



On this Republic control board are mounted all gauges, meters and controls for operating each of the two boilers and their auxiliaries.

MADE *Automatic*

made up of one electrical panel, one recorder panel, and two combustion control panels per boiler. All panels are joined together to form one continuous board for the two boilers. The boilers are rubber mounted to reduce vibration, are gray in color, and lighted from an overhead canopy.

The REPUBLIC combustion control system receives its initial impulse from the main steam line through the master controller which establishes a pneumatic loading pressure proportional to the boiler load. The loading pressure is transmitted to the variable speed coal feeders, and to the gas flow valve when burning gas in combination with coal. This pressure is also transmitted to the air flow regulator. A corrector regulator provides means for maintaining the proper steam flow air flow relationship. Provision has also been made for manually adjusting this ratio from the boiler panel.

Air flow and furnace pressure are regulated by hydraulic coupling speed, but fan damper controls are provided for use at extremely low loads, when the fan speed would be reduced below 30% of the motor drive speed.

The boiler feedwater pumps are equipped with REPUBLIC automatic minimum flow hand reset valves. These valves open when the flow through the pumps is 150 gpm or less and by-pass this amount of water to the deaerating heater.

The REPUBLIC feedwater regulator is located on the operating floor and can be manually operated during emergencies from the boiler control panel. The valve control is pneumatic, single element, but the valve is operated by a hydraulic cylinder.

For complete information on REPUBLIC automatic boiler control write for Data Book No. S-21.

REPUBLIC FLOW METERS CO. ● 2240 DIVERSEY PARKWAY • CHICAGO 47, ILLINOIS

BRIDGEPORT BRASS COMPANY
CONDENSER AND HEAT EXCHANGER TUBE EDITION

COPPER ALLOY BULLETIN

"Bridgeport" BRASS CO. MILLS IN BRIDGEPORT, CONN. AND INDIANAPOLIS, IND.—IN CANADA: NORANDA COPPER AND BRASS LIMITED, MONTREAL

PROPERTIES OF 90-10 CUPRO NICKEL As Compared to the 80-20 and 70-30 Alloys

Government restrictions for nickel often require the replacement of 80-20 and 70-30 Cupro Nickel condenser and heat exchanger tubing with 90-10 Cupro Nickel or alloys containing no nickel. Fortunately, the addition of 1 to 1.75% iron to 90-10 Cupro Nickel alloy has greatly improved its resistance to impingement corrosion and general corrosion from saline cooling waters, so that it compares favorably with 70-30 cupro containing 0.5% iron.

In answer to many requests for data regarding the physical properties of 90-10 Cupro Nickel, we have compiled a table covering the available information on the physical and mechanical properties of this alloy and 70-30 and 80-20 Cupro Nickel alloys.

Effect of Nickel Content

From a mechanical standpoint there are differences among these alloys. The higher the nickel content, the stronger and harder the alloy.

There is no appreciable difference in density or coefficient of expansion among all three. However, there is a considerable difference in thermal conductivity, with the 90-10 alloy being about 50% higher than the 70-30. The same is true for the thermal capacity. The thermal differences are not significant in affecting heat exchanger design, as recognized by those most familiar with the calculation and measurement of heat transfer rates.

There is some difference in electrical resistivity or conductivity which is significant in resistance welding techniques. Although no published data are available on the resistance and metal arc welding properties of 90-10, reports from the field indicate that this alloy yields good to excellent welds.

90-10 Cupro Nickel is being used in place of 70-30 Cupro Nickel in the manufacture of Duplex Tubing. The most popular combinations involve 3S aluminum, stainless steel and low carbon steel-lined or clad with 90-10 Cupro Nickel.

TABLE II
COMPARATIVE PHYSICAL AND MECHANICAL PROPERTIES OF CUPRO NICKEL ALLOYS

ANALYSIS	70-30 Nominal	70-30 Commercial Limits**	80-20 Nominal	80-20 Commercial Limits**	90-10 Nominal	90-10 Commercial Limits**
Copper	70%	66 min.	80%		90%	
Nickel	30%	29 min.–33 max.	20%	19 min.–23 max.	10%	9 min.–11 max.
Iron		0.6 max.		0.6 max.		1.0 max.
Zinc		1.0 max.		1.0 max.		1.0 max.
Lead		0.05 max.		0.05 max.		0.05 max.
Manganese		1.0 max.		1.0 max.		1.0 max.
Tin		1.5 max.		1.0 max.		

MECHANICAL PROPERTIES	70-30 Soft	70-30 Hard	80-20 Soft	80-20 Hard	90-10 Soft	90-10 Hard
(a) Tensile Strength, 1,000 psi	55	80	49	80	45	60
(b) Yield Strength, 1,000 psi	22	70	14	75	15	55
(c) Elongation in 2 inches %	45%	5%	40%	3%	40%	8%
(d) Contraction in Area %	75%	*	*	*	*	*
Rockwell Hardness, F scale	*	*	F 71	F 107	F 65	*
(e) Rockwell Hardness, B scale	B 35	B 84	B 25	B 81	*	B 75
(f) Elastic Limit psi	14-18	64-69	11-17	64-78	*	*
(g) Modulus of Elasticity in Tension, psi	22,000,000		20,000,000		*	

PHYSICAL CONSTANTS			
Density at 68°F, lbs./cu. in.	0.323	0.323	0.323
Specific Gravity	8.94	8.94	8.94
Melting Point °F, Liquidus	2260°F (1240°C)	2190°F (1200°C)	2090°F (1145°C)
Solidus	2140°F (1170°C)	*	*

THERMAL			
(a) Coefficient of Thermal Expansion per °F from 68°F to 572°F	9.0 x 10^{-6}	9.1 x 10^{-6}	9.3 x 10^{-6}
per °C from 20° to 300°C	16.2 x 10^{-6}	16.4 x 10^{-6}	16.7 x 10^{-6}
(b) Thermal conductivity at 68°F Btu/sq. ft./ft./hr./°F	17	21	26
(c) Calories/cm^2/cm/sec/°C @ 20°C	0.07	0.09	0.11
(d) Thermal capacity (spec. heat) @ 68°F	0.09 Btu./lb./°F	*	*
@ 20°C	0.09 cal./gm/°C	*	*

ELECTRICAL			
(a) Resistivity, ohms/mil foot @ 68°F (annealed)	225	160	113
(b) Conductivity, % I.A.C.S. @ 68°F (annealed)	4.6%	6.5%	9.2%
(annealed) megmho-cm^2 @ 20°C	0.027	0.038	0.053
(c) Resistivity, microhm centimeters @ 20°C (annealed)	37	27	19
Color	White Silver	Dull White Silver	Pink Silver

FABRICATION PROPERTIES			
Cold working	Good	Good	Good
Hot working	Good	Good	Good
Hot working Temp. °C	925-1000°C	900-1010°C	850- 950°C
Hot working Temp. °F	1700-1900°F	1650-1850°F	1550-1750°F
Machinability rating (d)	20	20	20
Soft soldering	Excellent	Excellent	Excellent
Silver soldering	Excellent	Excellent	Excellent
Oxyacetylene welding	Good	Good	*
Carbon arc welding	Fair	Poor	*
Resistance welding	Excellent	Good	*
Metal arc welding	Excellent	Good	*
Polishing	Good	Good	Good
Annealing temperature	1250-1600°F	1200-1600°F	1150-1600°F

SPECIFICATIONS—TUBE:		
ASTM-B 111-49	ASTM-B 111-49	ASTM-B 111-49
MIL-T-15005 Amend. 4		MIL-T-15005 Amend. 4
U. S. Navy 44T 39a		
MIL-T-16420 (Ships) 1 July 1951 (Supersedes 44T 40a)		

*Data incomplete.
**A.S.T.M. Specifications

(7479)

these steam traps won't freeze up!

Freeze-ups of outdoor steam traps in winter weather often cause production delays. Don't take that chance . . . especially when it's so easy to install Yarways, the steam traps that *won't freeze up.*

They won't freeze because condensate does not accumulate. The only moving part—a little valve—is continually testing for condensate, discharging it as soon as it forms. There's never anything to freeze.

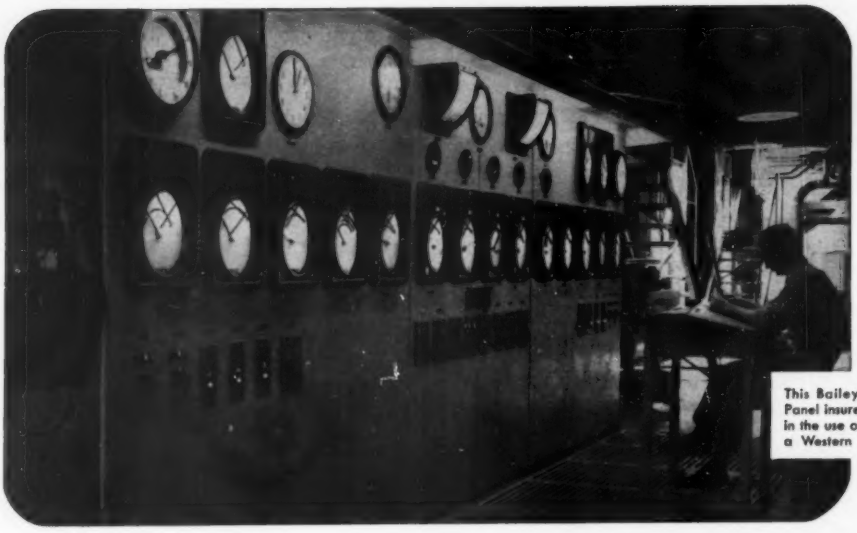
Other reasons why over 750,000 Yarway Impulse Steam Traps have been sold—they get equipment hotter, sooner; light weight; small size; easy to install and maintain; good for all pressures; made of stainless steel.

More than 200 industrial distributors sell Yarway Traps and Strainers. See your nearest one today. For name, and free 24-page Steam Trap Book, write . . .

YARNALL-WARING COMPANY
114 Mermaid Ave., Philadelphia 18, Pa.

YARWAY

the steam trap designed with more production in mind



This Bailey Boiler Control Panel insures high efficiency in the use of Fuel-Dollars at a Western Chemical Plant.

What's Your Fuel-dollar Efficiency?

A dollar's worth of fuel has the *same potential* energy, no matter who's boiler it fires. But how much of the energy actually gets converted to a usable form depends on how you operate your boiler.

That's where Bailey Controls can help. And, here's why, we believe, you'll get better fuel-dollar efficiency with Bailey:

1. **Complete Range of Equipment—fully co-ordinated.** You need never worry that a Bailey Engineer's recommendation is slanted in favor of a particular type of equipment, just because he has a limited line to sell—or that Bailey will pass the buck for efficient control; we offer *complete* boiler control systems.

2. **Engineering Service—backed by experience.** No other manufacturer of instruments and controls can offer as broad an experience, based on successful installations involving all types of combustion, flow measurement and automatic control.

3. **Direct Sales-Service—conveniently located near you.** Bailey Meter Company's Sales-Service Engineers are located in more industrial centers than those of any other manufacturer of boiler control systems; you get prompt, experienced service with a minimum of travel time and expense.

•

For better fuel-dollar efficiency—for more power per fuel-dollar, less outage and safer working conditions, you owe it to yourself to investigate Bailey Controls. Ask a Bailey Engineer to arrange a visit to a nearby Bailey installation. We're proud to stand on our record: "More power to you!"

A-109-1

BAILEY METERS

BAILEY METER COMPANY

1040 IVANHOE ROAD
CLEVELAND 10, OHIO

Controls for Steam Plants
COMBUSTION · FEED WATER
TEMPERATURE · PRESSURE
LIQUID LEVEL · FEED PUMPS

DIAMOND
SOOT BLOWERS

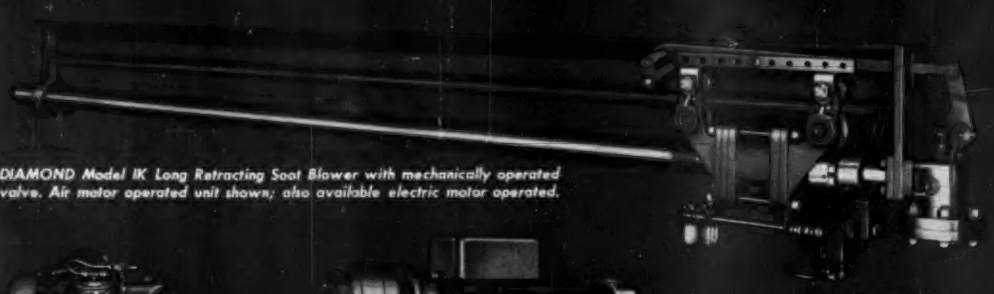
Meet the challenge of HIGH BOILER AVAILABILITY

The greater emphasis being placed on high boiler availability indicates the equal importance of high soot blower availability. The first can be limited by the second.

No other power plant equipment takes the "beating" to which soot blowers are daily subjected. Elements are exposed to repeated, sudden and severe thermal shock . . . to extremes of temperature, erosion and corrosion.

Diamond has long paid particular attention to "high availability" in its research . . . in the design, in the selection of materials and in the manufacture of all Diamond Soot Blowers. That they excel in this direction also is attested by their performance records . . . and by the preference they have long enjoyed among the most critical users of boiler equipment. The next time you need soot blowers, it will pay you well to select Diamond Soot Blowers.

DIAMOND POWER SPECIALTY CORP.
LANCASTER, OHIO
Diamond Specialty Limited • Windsor, Ontario



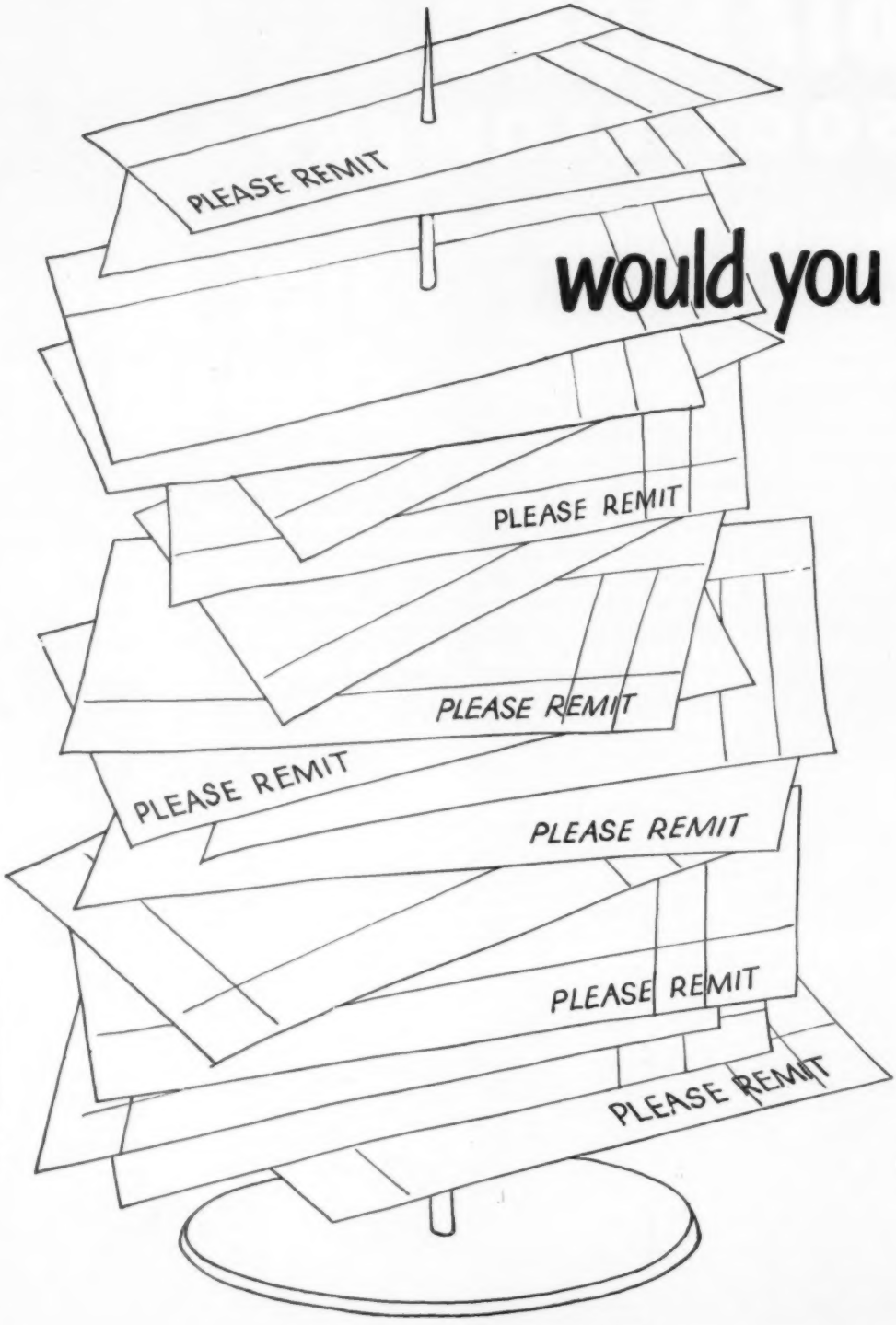
DIAMOND Model IK Long Retracting Soot Blower with mechanically operated valve. Air motor operated unit shown; also available electric motor operated.

DIAMOND Model G9B Soot Blower. Air operation shown; also available for manual or electric operation.

DIAMOND Model IR Short Retracting Soot Blower. Electric operation shown; also available for manual or air operation.

DIAMOND Model A2E Automatic Air Puff Soot Blower.

There is a DIAMOND Soot Blower . . . for Every Boiler Cleaning Requirement


PLEASE REMIT
would you
PLEASE REMIT
PLEASE REMIT
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PLEASE REMIT
PLEASE REMIT
PLEASE REMIT

pay 16 times

FOR THE SAME CONTROL SYSTEM?

Of course you wouldn't — but maybe you *do*.

Let's consider a few figures. At a conservative estimate, a good boiler will give you 200,000 hours of service. If it is a 100,000 lb/hr boiler it will burn during that time not less than $8,000,000 worth of fuel—even at today's prices.

If, through failure of your control system to give maximum combustion efficiency, you waste as little as *one per cent* of that fuel, your control system will have cost you $80,000—in addition to what you paid for it originally.

You will still have the same control equipment (you started with)—but you will have paid for it *sixteen times* over!

With a system by Hagan, you pay for your control just *once*. Hagan Automatic Combustion Control Systems are designed for *precise* control. When they are placed in service, they are adjusted by Hagan's experienced combustion engineers, who make sure that you *get* the precision which is built into the control system.

Then, by way of extra dividends, Hagan gives you *long life* and *low maintenance*. The ruggedly built components of the Hagan system last as long as the boiler—and longer. Simplicity of design, using the fewest possible parts, and affording minimum opportunity for wear, makes maintenance especially easy and inexpensive.

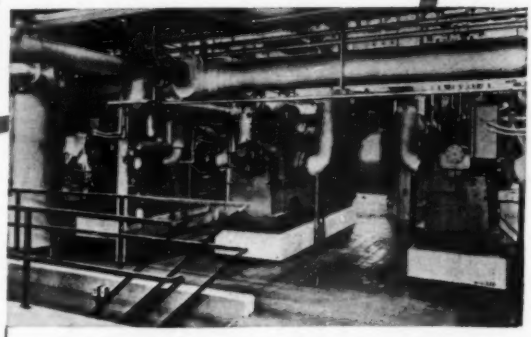
Hagan controls are used on every size of boiler from 5,000 pounds per hour at 3 psi to 1,340,000 pounds per hour at 1800 psi. They have been applied to boilers burning oil, coal, gases of various types, sawdust—and always with satisfactory results.

Our engineers will be glad to give you full information on Hagan control systems. Write to Hagan Corporation, Hagan Building, Pittsburgh 30, Pa.

HAGAN CORPORATION

BOILER COMBUSTION CONTROL SYSTEMS
RING BALANCE FLOW AND PRESSURE INSTRUMENTS
METALLURGICAL FURNACE CONTROL SYSTEMS
THRUSTORQ FORCE MEASURING DEVICES

What Metals Are Best For Centrifugal Boiler Feed Pumps?

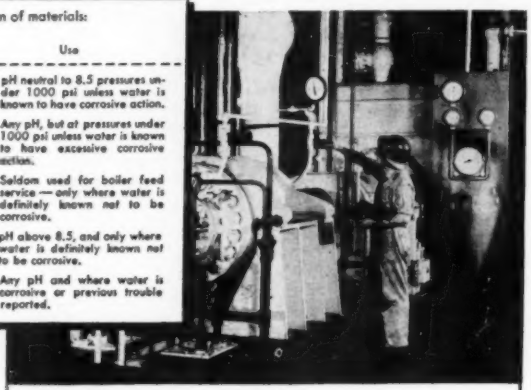


Three Worthington Axially Split Centrifugal Boiler Feed Pumps At The Kansas Power And Light Company Plant, Hutchinson, Kansas.

Drawing on their long experience in the field of hydraulics, Worthington engineers produce boiler feed pumps that are metallurgically correct in design, meeting every requirement as to temperature, pressure and corrosion-erosion resistance. As a result, Worthington boiler feed pumps perform better and last longer.

The following table represents Worthington's recommendation of materials:

Casing	Fittings	Maximum Temperature	Use
1. Cast Iron	Bronze	250 F	pH neutral to 8.5 pressures under 1000 psi unless water is known to have corrosive action.
2. Cast Iron	13% Chromium Stainless Steel	350 F	Any pH, but at pressures under 1000 psi unless water is known to have excessive corrosive action.
3. Carbon Steel	Bronze	250 F	Seldom used for boiler feed service — only where water is definitely known *not* to be corrosive.
4. Carbon Steel	13% Chromium Stainless Steel	400 F	pH above 8.5, and only where water is definitely known *not* to be corrosive.
5. 5% or higher Chromium Steel	13% Chromium Stainless Steel	Any temperature normally encountered	Any pH and where water is corrosive or previous trouble reported.



One of Several Solid Barrel, Radially Split, High Pressure Boiler Feed Pumps at the Trenton Channel Station of the Detroit Edison Co.

This proven selection of materials coupled with the most advanced design, superior workmanship and a thorough knowledge of application show why . . .

THERE'S A *RIGHT* WORTHINGTON PUMP FOR YOU

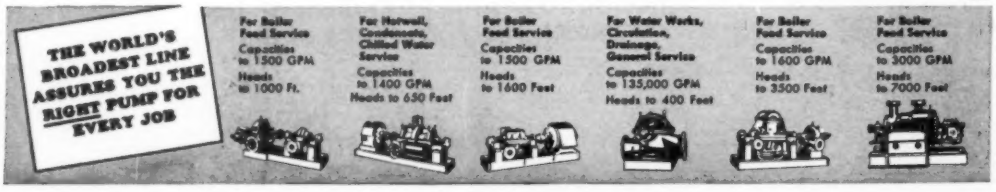
. . . *right* for the pressure and temperature of your boiler feed service . . . *right* for maximum economy and dependability. For further proof that *there's more worth in Worthington*, contact our nearest District Office, or write to *Worthington Pump and Machinery Corporation, Centrifugal Pump Division, Harrison, N. J.*

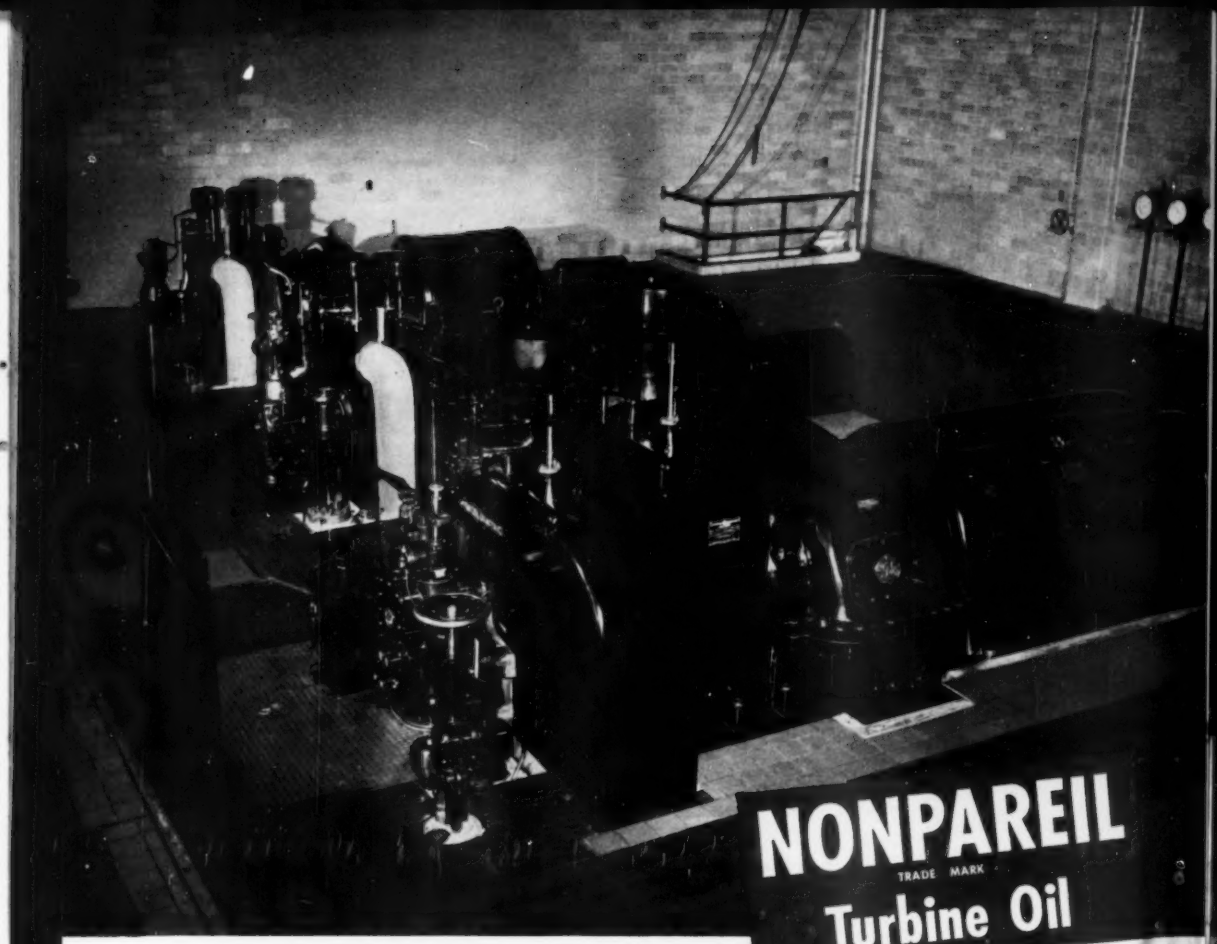
MEMBER

WORTHINGTON

C1.2

THE WORLD'S BROADEST LINE ASSURES YOU THE RIGHT PUMP FOR EVERY JOB


For Boiler Feed Service
Capacities to 1500 GPM
Heads to 1000 Ft.
For Hotwell, Condensate, Chilled Water Service
Capacities to 1400 GPM
Heads to 650 Feet
For Boiler Feed Service
Capacities to 1500 GPM
Heads to 1600 Feet
For Water Works, Circulation, Drainage, General Service
Capacities to 135,000 GPM
Heads to 400 Feet
For Boiler Feed Service
Capacities to 1600 GPM
Heads to 3500 Feet
For Boiler Feed Service
Capacities to 3000 GPM
Heads to 7000 Feet



Seventeen years . . . a sweet record

In the latest semi-annual laboratory check, the NONPAREIL Turbine Oil which has served in these turbines for 17 years without removal for treating or resting showed a neutralization number of only 0.03 mg. KOH/gm. That's a low acidity record . . . a sweet record.

Installed in the two 1250-KW generators in the background in June 1934, and in the 2500-KW unit (foreground) in 1947, NONPAREIL has never required removal for treating or for cleaning of the common lubricating system. The result: real operating economy and trouble-free lubrication for Theo. Hamm Brewing Company, St. Paul, where these turbines are in service.

Performance like this was assured when the original fill was made . . . not for just this 17 year period, but for the life of the turbines themselves. Like other NONPAREIL users, Theo. Hamm Brewing Company received a written guarantee that NONPAREIL Turbine Oil will maintain a neutralization number below 0.15 mg. KOH/gm.

Why not work toward the same sweet record of performance in your own turbines through the use of NONPAREIL Turbine Oil? Ask a Standard Oil lubrication specialist to show you service records covering periods up to 23 years. Just call the Standard Oil office nearest you, or write: Standard Oil Company, 910 So. Michigan Ave., Chicago 80, Ill.

STANDARD OIL COMPANY STANDARD *(Indiana)*

When choice materials are scarce

you'll be glad you own

The New

ROTOJET®

TUBE CLEANERS

Rotojet owners can expect little or no maintenance problems during the critical times ahead. Simple design has always been a basic feature of Rotojet Motors, which have only two moving parts. That is a very important advantage, especially when quality materials for replacement parts are in short supply.

Replacement parts have always been available for Rotojet Cleaners. During our 40 years of tube cleaner specialization, prompt, efficient service has earned us the good will of our thousands of customers. To help owners of old and new Rotojet equipment to get maximum service, we have prepared a folder showing various accessories which will prolong the life and improve the performance of tube cleaners. We invite you to write for a free copy.

SEND FOR NEW ROTOJET BULLETIN

THE SECRET

ROTOJET Motor has only two moving parts, a shaft and a paddle. Positive contact between paddle and Rotocentric (egg-shape) bore cylinder prevents stalling at low speeds. No leakage. Delivers maximum power for air used.

ELLIOTT COMPANY-ROTO DIVISION

147 Sussex Avenue, Newark 1, N. J.

BOKARO

(Continued from page 89)

the breaker on the occurrence of a fault. In addition, each 3150-v bus has inverse time induction overcurrent relays for backup protection.

The 400-v station service transformers are protected by standard time, very inverse, induction overcurrent relays with instantaneous trip.

Battery

The control voltage for this station is 250 v, direct current. A 120 cell lead acid storage battery having an eight hour discharge rate of 80 amperes is installed in a battery room on the electrical gallery. Two (2) 10 KW motor generator sets are provided for charging the battery; one floats on the battery at all times and the other is used as a standby. This battery supplies control power for the entire station including the outdoor substation and also supplies emergency lighting.

Communication

Communication in the plant consists of two parts.

(a) Loudspeaker system

(b) Plant Telephone System

The loudspeaker system consists of three (3) separate systems, one for each unit, and is used for supervision of boiler and turbine operation. Microphone handsets are located at essential points throughout the plant. Muting switches to prevent feed back, and an oscillator circuit for call signals is provided at each hand set station. A special arrangement of microphones in the electrical control room enables a general announcement (as in case of emergency) to be made over the entire station. A selector switch arrangement is also provided in the control room for communication with each system, independently.

The plant telephone system consists of about 70 handsets located at all essential areas throughout the station, and is used for all general intercommunication. The P.B.X. telephone switchboard is located on the electrical gallery.

Carrier current telephone facilities provide communication over the 138 KV lines to the outlying stations. Two (2) lines to the public telephone system have also been provided.

Lighting

The station lighting system operates at 230 volts and is supplied from the reserve 400/230 volt bus. In case of failure of the normal lighting source emergency lights, which are located at all essential parts of the power house, are automatically switched on.

The turbine room, offices, switchgear bays, and electrical control room are illuminated by fluorescent fixtures. All other areas are illuminated by incandescent fixtures. The electrical control room is illuminated

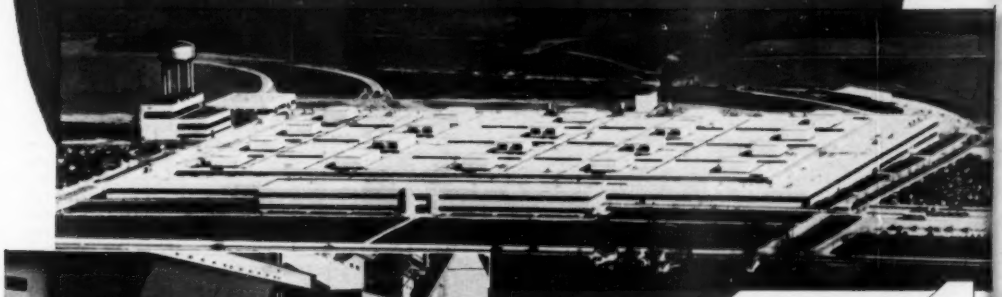
DETROIT STOKERS

Western Electric dialed the right number

Western Electric engineers dialed the right number when they selected Detroit RotoGrate Stokers for their new Indianapolis Plant—the world's largest factory devoted to making telephone sets.

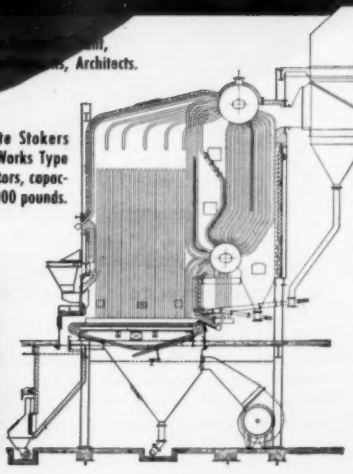
Detroit RotoGrate is the original spreader stoker with [illegible] moving grates that discharge ash at the front. It burns any Bituminous coal or Lignite and may be adjusted from one fuel to another. Furnish higher burning rates to produce more capacity per [illegible] of furnace width.

RotoGrate Stokers easily handle fluctuating loads—have a record of exceptional efficiency with a wide variety of [illegible]. • Write for Bulletin.



[illegible], Architects.

Detroit RotoGrate Stokers with Union Iron Works Type VO steam generators, capacity each unit, 60,000 pounds.



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SHEET PACKING
RUSSO is a compressible sheet that will make up tight and stay tight. Its homogeneous construction of long asbestos fibers permits easy and true cutting into gaskets. Complete graphite impregnation to prevent flange adherence and heat resisting binder to take years of punishment. When you want to be sure of a joint: be certain to specify Chesterton RUSSO.
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A. W. CHESTERTON CO., 6 Ashland St., Everett 49, Mass.

☐ I would like more data on "210"

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by fluorescent strip lights placed above a luminous ceiling. The average intensity of illumination in the control room is 40 footcandles. The intensity of illumination in the turbine room and switchgear areas is 25 footcandles and other areas are maintained at from 10 to 15 footcandles.

Outdoor lighting is supplied by a 300-kva 3000/400/230-v transformer. All essential work areas are adequately floodlighted. Substation lighting and roadway lighting are also provided.

Power and Control Cables

All control cables are multi-conductor color coded cables with moisture resistant thermoplastic (TW) insulation. Control cables throughout the plant are run in open metal trays, individual conduit construction being used only in short isolated runs. Control cables in the substation are run in rigid steel conduit.

All power cables are run in rigid steel conduits. All 600-v cable is insulated with a heat-resistant rubber compound and covered with a neoprene jacket. In general, 5000-v cable is insulated with a heat and ozone resistant rubber compound and covered with an outer jacket of neoprene.

HOW TO BUY COAL

(Continued from page 60)

From March to July coals were divided into categories of *high* and *low* fusion in order to compare like coals. After July reports were compiled in terms of individual plants regardless of types of coal.

The selection of the base of comparison of coal sources is an interesting problem. High fusion coals generally cost more than low ash fusion types and would show up unfavorably in a cost report that included lower grade coals. Carbon sizes of coal would certainly show up at a lower cost than 2-in. nut and slack. It has been the opinion of the author that the cost of the heat purchased and delivered to any given plant is the dominating factor regardless of the type of coal, providing the coal meets the operating requirements of the plant. Plants designed for lower grade and lower cost coals need not be supplied with premium coals at high costs.

Figure 2 visually points out what can happen during emergency periods to coal quality and costs. It demonstrates the value of graphic charts of this type, bringing into the picture factors not covered in regular reports, or depicting properties in continuous graphic form.

A third chart, Fig. 3, provides background for the previous charts in depicting the weekly average ash and moisture content of the coals consumed at the two plants, the analyses being derived from bunker samples. These curves point clearly to the fact that moisture was the prime offender

during the emergency period in lowering heat values and raising cost levels. Daily bunker samples form a good composite of the total quantities of all the various coals unloaded. This applies especially to Plant B which has a continuous automatic sampling machine operating 24 hours a day capable of accumulating a sample of all the cars of coal unloaded during the day. With limited personnel and laboratory facilities it is impossible to sample cars from all suppliers even in a week's time.

These various curves show the interrelationship of the various characteristics of the coal. They supply interesting information auxiliary to the data of the weekly report. For a smooth means of portraying the trend in coal costs a moving quarterly average is helpful. Fig. 4 illustrates such a chart for the two plants. Each week's point is the average of the three-month period ending with that week. The new weekly weighted average for each plant is added while the first week's figure of the three-month period is dropped. The smooth curve thus formed is unaffected by fluctuations that may be the result of momentary deviations in shipping, preparation, weather, sampling, and so on. The curves move slowly up or down with definite and more lasting changes in quality, prices, economics, and procurement procedures.

This article is presented merely to portray one method of recording and evaluating the progress of a coal procurement program. There are probably many others with different approaches. It would be interesting to learn of them. The items considered are of a variable and technical nature. Permanent factors relating to the source of coal that are equally important to the buyer, such as financial stability, production capacity, mining and cleaning methods, rail facilities, etc., are outside the purview of the reporting discussed. Once determined these factors become established and in no need of continuous evaluation.

GAS-TURBINE ELECTRIC LOCOMOTIVE

(*Continued from page 70*)

a freight through a long tunnel at a very slow speed. The temperature-limiting control, which should have unloaded the turbine, failed to function and has since been replaced with one more suitable for locomotive service.

After repairing the failed gas-turbine unit by replacing the turbine blading, the locomotive was arranged for a series of special tests at the East Pittsburgh Works. These tests covered firing one gas turbine unit with various grades of residual oils having various viscosities and ash content. The tests were made by connecting the d-c generators from one gas-turbine unit to a water rheostat, allowing tests to be made over the complete load range. The residual

Chesterton *Centrifo*

THE CENTRIFUGAL PACKING ***that spares the rod without spoiling the seal***

"Centrifo" is a soft, highly lubricated packing made from the silkiest of cotton fibres. As it tends, blotter like, to absorb the liquid which it seals, it always remains soft and pliable. It won't score brass shafts, sleeves or rods even at speeds up to 4000 rpm.

Chesterton Centrifo gives a packing seal superior to square flax or braided asbestos on centrifugal or rotary pumps handling hot or cold water, brine or cold oil.

To spare the rod without spoiling the seal specify Chesterton Centrifo. Order today from your Industrial Jobber and observe how "Centrifo" holds the seal and eliminates expensive pump repairs.

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Why it pays to be a DART UNION MAN!

This True Ball Joint Makes the Difference

Precision-ground to a perfect sphere, the true ball joint of a Dart gives a snug, drop-tight fit — quickly, easily. You don't have to put your back into it — fuss — or lose valuable productive time when installing. Yes, and they uncouple as quickly . . . ready for re-use — for Darts have more lives than a cat! (Seats stay clean and unmarred.)

Darts are a better buy also because their *bronze-to-bronze* seats offer maximum resistance to pitting and corrosion — their body and nut of high-test, air-refined malleable iron are practically indestructible.

For these and other reasons you'll agree . . . once a Dart Union man, always a Dart Union man!

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oils were tested both "as received" and after centrifuge treatment.

Results of the residual oil tests show that selected grades of this fuel can be burned successfully. The fuel control and handling is more difficult and there is a marked reduction in flame tube life. The tests have been too limited to draw any conclusion as to the merit of centrifuging residual oil to remove some of the ash constituents. Laboratory tests are being made on residual oils to which inhibitors have been added, to determine the effect these inhibitors have on neutralizing the harmful ash with respect to corrosion and deposition on hot turbine parts.

On completion of these special fuel tests, the locomotive was placed in service on the Pittsburgh and Lake Erie Railroad using residual oil fuel.

While over-all road operation of this unit has been good, considerably more road experience is necessary before any comparison can be made with other types of motive power.

TAKE A WALK

(Continued from page 67)

the feedwater heater, will give more exhaust steam than can be absorbed by the heater. In such case, it may pay to look into the question of installing electric-driven feed pumps and compressors for use in the summertime, thereby cutting down surplus and wasted exhaust steam.

But whatever the case in this respect, the feedwater should be heated by exhaust steam. For boiler pressures common thirty years ago, a 1 per cent fuel saving results for each 10 to 11 F thus added to the water entering the boiler.

How Is Steam Distributed?

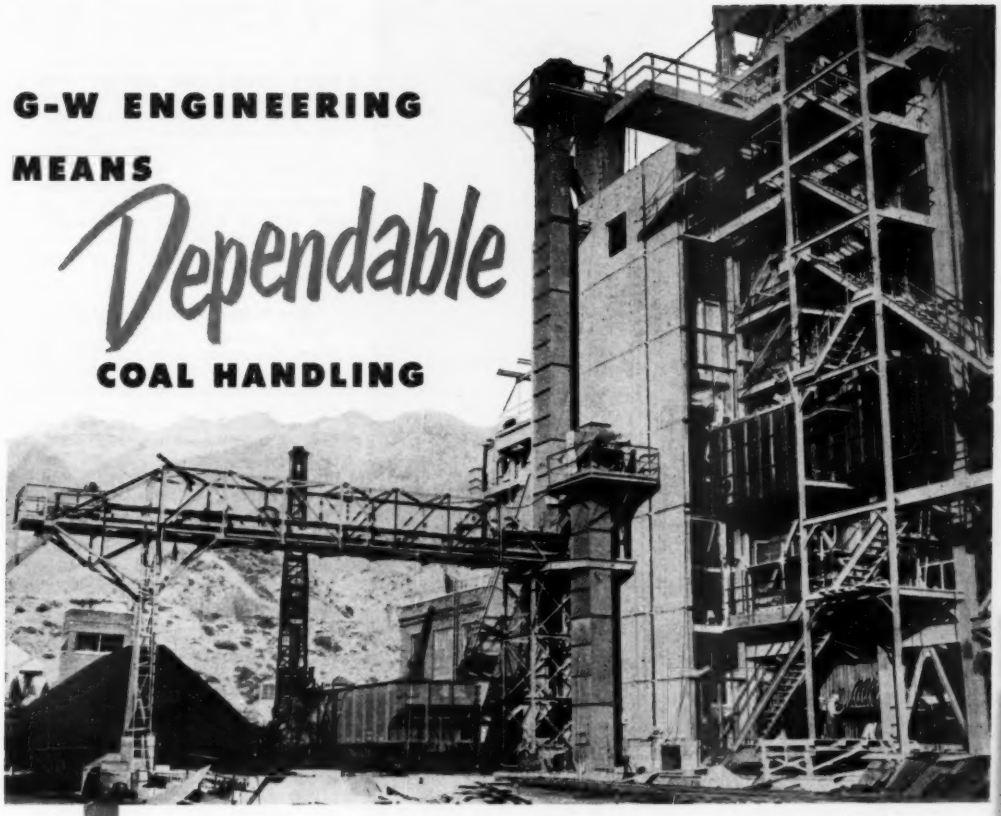
Having inspected the steam-producing department, we are interested to see how this expensive commodity is being distributed and applied. At the same time, information will be sought on the use of electricity, water, and gas. We shall secure from the engineer some key figures on the character of the electric load and sample monthly bills for purchased power, together with corresponding information on steam requirements and pressures. From these we can quickly determine whether or not there may be a possibility of substituting generated power for the purchased supply, and whether or not a further study of this question should be made.

An examination of the existing load factor and power factor will indicate whether a reasonable improvement of these may offer opportunity for a substantial reduction in the cost of purchased power.

As we walk along, we shall keep an eye on the piping system. Plant engineers have sometimes been able to remove a mile of unnecessary pipe with good savings in heat losses and maintenance.

In any extensive establishment,

G-W ENGINEERING MEANS *Dependable* COAL HANDLING



The Gifford-Wood coal handling system at the Orem steam electric station of Utah Power & Light Company is designed to handle run-of-mine bituminous coal at 100 tons per hour from dual track hoppers to ground storage, or to overhead storage bins for automatic delivery to boilers. Coal handling is automatic . . . economical . . . completely dependable. The installation, protected by electrical interlocks, is a perfect example of the rugged design and flexibility that can be built into the operation of a well designed power plant.

This complete coal preparation and handling system is but one of the many solutions to dependable low cost coal handling . . . Solutions designed by G-W engineers . . . based upon over 135 years of experience accumulated by G-W in the methods of design, engineering and installation of all types of materials handling systems. Bulletin No. 300 contains the complete story. Send for your copy now, it may well lead to lowered costs tomorrow.

GIFFORD-WOOD CO.

Since 1814
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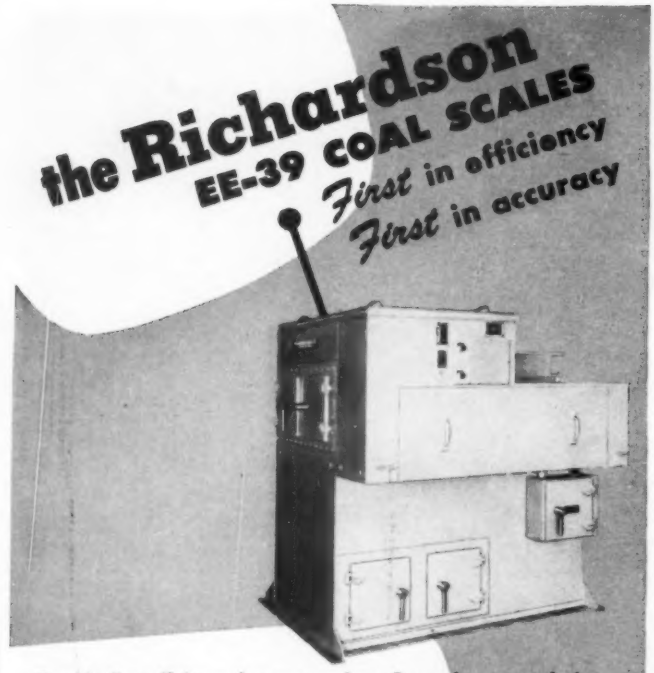
When You Think of Materials Handling . . . Think of Gifford-Wood



Low boiler efficiency is a money hog. It can be stopped almost before it starts—with a Richardson EE-39 Coal Scale. Here are some of the reasons the EE-39 should be your first consideration. Compare them with any other scale *BEFORE* you buy.

- **A 20" x 20" inlet opening, biggest of any coal scale assures positive coal flow—no "hanging-up."**
- **Simple-to-operate by-pass mechanism, enabling coal to be re-routed to stoker or pulverizer.**
- **Pivoted leveling plate provides shallow, even coal flow, uniform "breakaway." Eliminates power or belt strain when occasional lumps pass through.**
- **Warp and twist-free weigh beam of heavy, welded members, mounted on hardened steel knife edges.**
- **Pressure-tight access doors located to provide easy inspection of weighing chamber.**

PLUS —a complete line of accessories such as "Monorate" distributor, discharge counter, remote by-pass control, etc.

For complete information write now to Richardson Scale Co., Clifton, N. J. for Bulletin 0150.

Ask a Richardson engineer to survey your present methods of checking fuel consumption and boiler efficiency. His recommendations will be based on almost 50 years of materials handling by weight experience. No obligation, of course.

7488

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Richardson

MATERIALS HANDLING BY WEIGHT SINCE 1901

each production department should have its own steam and electric meters to measure and check consumption and economies as well as costs.

In addition to space heating, steam may be used for various processing, including evaporation, drying, heating of air or liquids, sterilizing, cooking, vulcanizing, digesting, and other applications.

With any of these, the principle of economy is the same; that is, the full value of the heat of the steam must be extracted and all clean condensate available should be returned for use in the boilers.

Are Traps Working Right?

In the case of coil or closed heating, where the steam does not come in direct contact with the medium being heated, a look at the trap system will be called for.

It is common practice for operators to open the by-pass of a trap, which then ceases to function as such and the consumption of steam may jump several hundred percent. Or the trap may simply be out of repair, causing a similar waste. The question is: how are these things kept under control in this plant?

In the case of high-pressure closed heating, with traps discharging at about atmospheric pressure, look out for a big loss. Flash steam in such cases will be in the order of 13 to 18 per cent of the heat supplied above 212 F for steam pressures ranging from 100 to 200 psi. This loss is recoverable by several means of utilizing this flash steam. In the direct heating of liquids in open vessels by either exhaust or boiler steam, the utilization of the heat can be practically perfect, but in practice it is usual for the operators to open valves so wide that it is easily possible to consume and waste twice the steam required. There are means to control this situation.

Is Waste Heat Reclaimed?

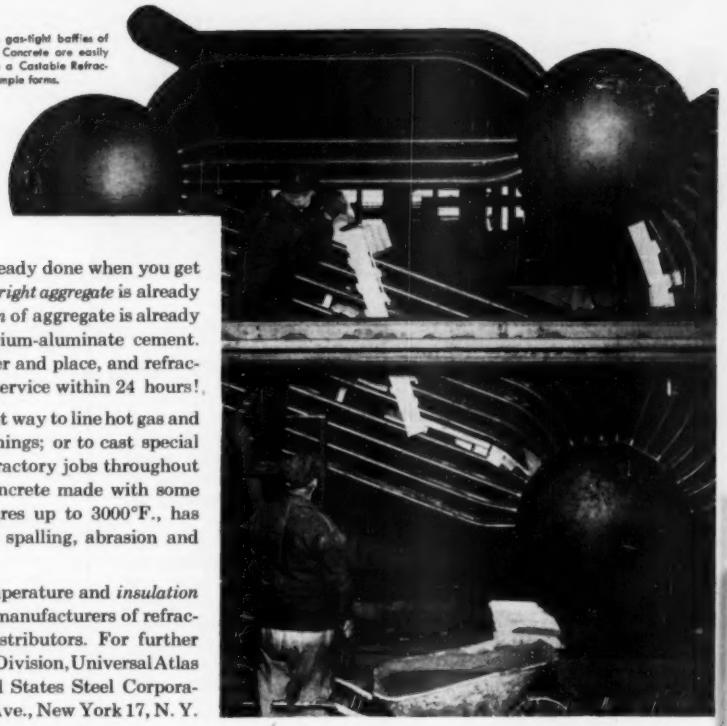
We shall be watching for places where large volumes of dirty hot waste water may be discharged as possible opportunity for reclamation of heat by exchangers; clean water waste will also incite further inquiry.

There usually will be found applications where exhaust steam can be substituted in place of boiler steam. It may be necessary to increase the heating surface and employ larger piping, the cost of which must be compared to the annual saving of fuel and reduction of load on the boilers.

Waste of steam generally occurs in space heating systems due to lack of control of temperatures, heating of unnecessary space and faulty trapping and return systems. We are likely to spot excellent potential savings as we look over this department.

High- and low-pressure condensate discharged through the same return system is a common cause of waste and inefficiency, and it is quite likely,

CASTABLES give you a *head start* on your next Refractory job

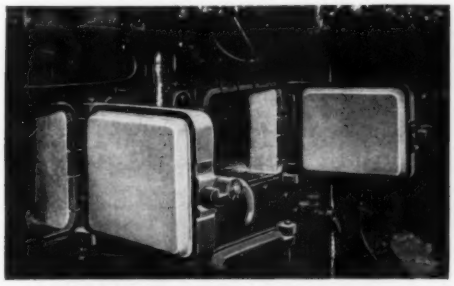


Monolithic, gas-tight baffles of Refractory Concrete are easily made with a Castable Refractory and simple forms.

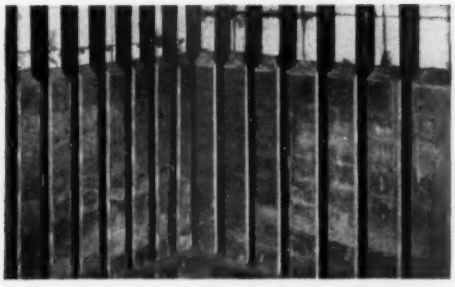
TWO PARTS OF THE JOB are already done when you get Castable Refractories. The *right aggregate* is already selected. The *right gradation* of aggregate is already mixed with Lumnite* calcium-aluminate cement. All you do is mix with water and place, and refractory concrete is ready for service within 24 hours!

That's the fast, convenient way to line hot gas and air ducts, stacks and breechings; or to cast special shapes . . . and do many refractory jobs throughout your plant. Refractory Concrete made with some Castables takes temperatures up to 3000°F., has low volume change, resists spalling, abrasion and corrosion.

CASTABLES to meet specific temperature and *insulation* requirements are made by manufacturers of refractories and sold by their distributors. For further information, write Lumnite Division, Universal Atlas Cement Company, (United States Steel Corporation Subsidiary), 100 Park Ave., New York 17, N. Y.



DOOR LININGS made with adaptable Castable Refractory Concrete. Unnecessary to stock large inventories of special shapes. Instead, special shapes can be cast in place or poured in molds as needed. Volume change is negligible.



TUBE PROTECTING Water Wall Studding made with a Castable Refractory is tough and highly radiant, uses a different aggregate than baffles (above). With Castables you get Refractory Concrete tailor-made for the job.

**"LUMNITE" is the registered trade mark of the calcium-aluminate cement manufactured by Universal Atlas Cement Company.*

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ATLAS® **LUMNITE for INDUSTRIAL CONCRETES**

REFRACTORY, INSULATING, OVERNIGHT, CORROSION-RESISTANT

A UNIVERSAL ATLAS PRODUCT

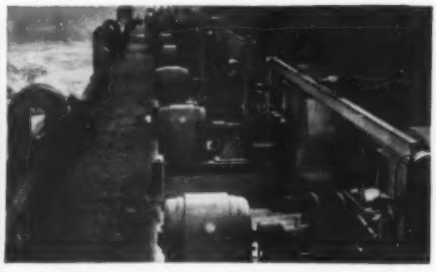
"THE THEATRE GUILD ON THE AIR"—*Sponsored by U. S. Steel Subsidiaries—Sunday Evenings—NBC Network*

A Big Draft Job Handled Capably by Green Fans

Twenty-four large Green Fans take care of a heavy draft load at the Venice (Illinois) Plant of the Union Electric Co. of Missouri. Each of six boilers has two sets of Green Fans, each set consisting of one induced draft fan and one forced draft fan coupled to one motor as a unit. With the heavy demands on this station, all boilers are usually in service continuously, thus throwing an unrelenting burden on the fans.

Engineers whose responsibility it is to recommend or accept draft fans for large power plants certainly want efficiency and low operating costs. But they don't overlook the maintenance and replacement angles. They want the sound designs of competent experienced fan engineers. They also want the care in construction that is found in shops of a company that has built up an international reputation as the "authority" on draft fans. They know that such a company will not tolerate sloppy shop work.

Green is this authority on mechanical draft fans.



Have You a Copy of Our Fan Bulletin No. 168? If not, we shall be glad to send you one.

THE GREEN Fuel Economizer COMPANY INC.

BEACON 3, NEW YORK

ECONOMIZERS • FANS • AIR HEATERS • CINDERTRAPS

judging by past experience, that we shall uncover some of these wasteful practices.

By the time we have completed this interesting walk through the plant, we shall know where lie the best possibilities of improving the operation of your existing plant without any major replacements or capital expenditures.

More detailed study of those items found to be outstanding by this preliminary inspection, will develop into a finished picture replete with recommendations and estimates of costs and savings.

PUMP CAVITATION

(*Continued from page 69*)

port or orifice in the burner. However, in no case is it recommended that screens finer than 100 mesh be used with residual oil.

In the handling of some liquids such as naphtha or gasoline, the vapor pressure of the liquid is a factor to be considered. The minimum pressure in the system should not be below the vapor pressure of the most volatile constituent of the liquid at the temperature in the system. If the above remedies do not meet this requirement, it will be necessary to install a boost pump at the liquid supply. This step may be required in the handling of a gassy crude oil, for example, where a small drop in pressure in the inlet line will evolve a large volume of gas from solution in the liquid. A centrifugal type pump will usually suffice in this case and should be installed at the bottom of the supply tank. Depending on the liquid used, it may also be possible to pressurize the supply tank.

All of the foregoing concerns performance at sea level conditions. Since the barometric pressure is progressively reduced as altitude increases, the losses in a pump inlet system must also be reduced to avoid cavitation. For example, at 6000 ft altitude, atmospheric pressure is about 11.8 psi, so that the combined inlet pipe and pump loss should be reduced from 10.5 to 8.4 psi.

NEWS FROM THE FIELD

(*Continued from page 97*)

Edison Co., Detroit, Mich.

Paul B. Eaton, head, mechanical engineering department, Lafayette College, Easton, Pa.

THE KELLEX CORP. BECOMES VITRO CORPORATION OF AMERICA

THE KELLEX CORP., specialist research and engineering firm, announced today that it has changed its name to Vitro Corporation of America, effective August 31. Organization, policies and services will continue as before.

Vitro Corporation of America was organized under its former name in January, 1943, as a subsidiary of the

FOR LOW-COST MAINTENANCE with the greatest of ease!

See how Darling cast steel gate valves save you time and money!

YOU know how important low-cost, *easy* maintenance can be. It's one of many Darling Valve features worth shouting about.

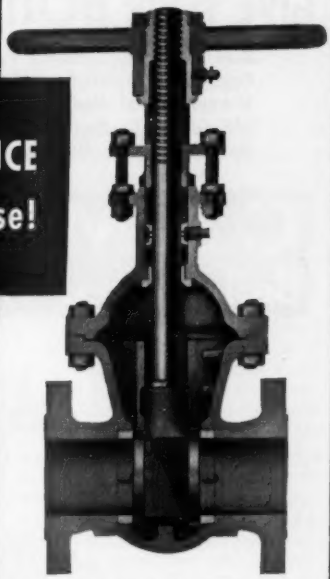
For example, all *Darling* parts are precision-made to jigs and templates. Replacement parts slip in quickly and easily.

What's more, Darling valves are designed so that seat rings and all working parts are easily removed and replaced without taking the valve bodies from the line.

These maintenance and repair advantages, plus many other time-and-money-saving features, apply to Darling gate valves of both popular types shown at right. It adds up to low-cost performance at its over-all *best!* Ask for the Darling Cast Steel Valve Bulletin. Get *all* the facts so you can judge for yourself!

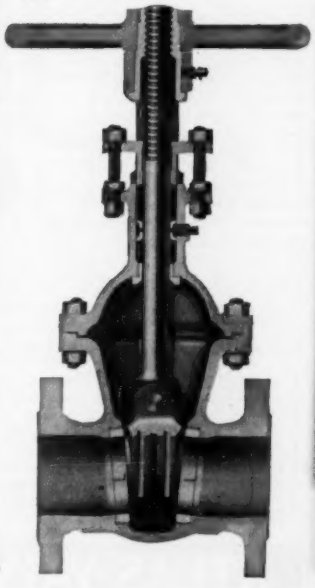
FOR PLUS VALUES, JOB-PROVED AGAIN AND AGAIN

FOR EVERY NEED. *Darling gate valves are made in a wide range of sizes, types and constructions for all kinds of normal and unusual service . . . and for pressures up to 1500 pounds.*



Above: *Cutaway showing Darling gate valve of the fully revolving double disc parallel seat type.*

Below: *Cutaway of Darling slotted wedge gate valve with double guide grooves.*



DARLING VALVE & MANUFACTURING CO.
Williamsport 19, Pa.

Manufactured in Canada by Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ont.

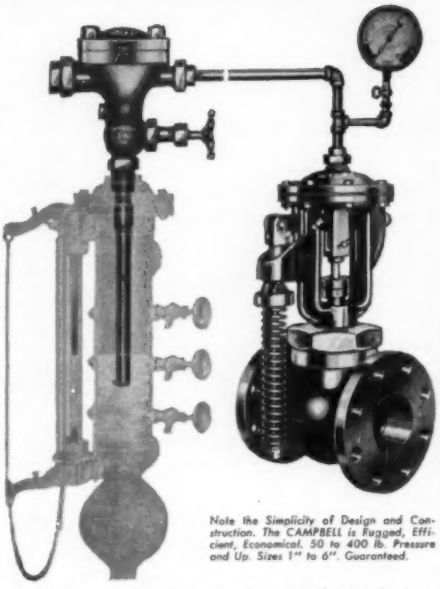
GIVE YOUR BOILER A CHANCE

Don't Let Fluctuating Water Level Cut Down its Capacity. Operate it Continuously at the Proper Water Level Height and Maintain Best Overall Efficiency Under Your Own Conditions. You Can do this by Installing a

CAMPBELL
Boiler Feed Water Regulator

Best Level. The CAMPBELL holds the water at the desired level continuously — without further attention and without any maintenance expense.

Simple. The principle, design, and installation are exceedingly simple. Once installed — by your own or a local pipe fitter — you are sure of ideal boiler feed regulation — needing no supervision. No thermostats. No floats. No links. No generators.



Note the Simplicity of Design and Construction. The CAMPBELL is Rugged, Efficient, Economical. 50 to 400 lb. Pressure and Up. Sizes 1" to 6". Guaranteed.

Operation. On sudden increase in load, the CAMPBELL automatically slows down the feed and allows time for the furnace output to be increased before the rate of feeding again equals the evaporation. On suddenly decreased load, the CAMPBELL momentarily increases the rate of feeding to absorb the excess heat of the furnace and store it in the boiler water instead of wasting it up the stack. Then when furnace and steam load are again in proper relation the normal water level is automatically restored. Dry steam output is assured.

- ☐ Super-sensitive Pressure Regulators
- ☐ Damper Regulators
- ☐ Temperature Regulators
- ☐ Reducing Valves
- ☐ Exhaust Control Systems
- ☐ Pump Governors
- ☐ Oil Control Cocks
- ☐ Humidity Controllers
- ☐ Thermostats
- ☐ Balanced Valves
- ☐ Control Valves

Other Advantages. We cannot give all of the advantages here, but we will name continuous blowdown and visible indication as *exclusive* CAMPBELL features. Bulletin 8-A tells all. Place a check in this square ☐ and we will send you a copy. And, for data on other ATLAS regulating devices check the list at the left and mail to us with your name, firm, and address.

Ask Our Engineers. Tell us the number and type of boilers you have and your boiler feed regulation troubles. ATLAS Engineers will gladly advise and quote prices if desired. They have had experience with hundreds of boiler feed regulation problems.

ATLAS VALVE COMPANY
REGULATING VALVES FOR EVERY SERVICE

Atlas Valve Co., 293 South St., Newark 5, N. J.

Represented in Principal Cities

M. W. Kellogg Co. During the war it engineered the famous gaseous diffusion plant at Oak Ridge, Tenn. Since the war it has designed major production facilities for the atomic plant at Hanford, Washington, and has been engaged in a number of vital projects for the Army, Navy and Air Force.

Main offices of Vitro Corporation of America will remain at 233 Broadway, New York City, research and development laboratories in West Orange and Jersey City, New Jersey, and in Silver Springs, Md.

E. G. BAILEY RECEIVES JOHN FRITZ MEDAL

ERVIN GEORGE BAILEY, past president of The American Society of Mechanical Engineers and vice-president of Babcock and Wilcox Co., was selected by the John Fritz Medal Board of Award to receive the 1952 John Fritz Medal and Certificate "for outstanding engineering achievements in the field of combustion and distinguished service to his fellows in advancing the engineering profession."

This award to Mr. Bailey is the culmination of a long series of honors which have been bestowed upon him for his achievement and leadership in steam and combustion engineering and in professional activities. He has been granted nearly one hundred patents involving improvements in efficiency and operation in fuel burning and steam generation. As an important aid to efficient combustion, he developed a boiler meter now in general use, manufactured by a company bearing his name, and which he headed as president.

Mr. Bailey is a member of several national professional societies and of several honorary engineering societies. He is one of the few American engineers who are honorary members of The Institution of Mechanical Engineers, London, England.

HELPFUL BULLETINS

(*Continued from page 38*)

makes of roller and conveyor chains. Also supplies information of value in determining proper application of chain drives as a power transmission or conveying medium. Describes and illustrates chain parts and types, provides comparative data, conversion tables, helpful formulas, trigonometrical functions, etc. Whitney Chain Co.

128 Tackle Blocks — Catalog 50-B, 5 pp, presents company's complete line of tackle blocks. Covers ordering instructions, policy service, design features, mechanics of tackle blocks, and provides dimensional data, weights, safe working loads, etc. Essential parts of tackle blocks — shell, sheave or grooved wheel, center pin, straps and connections — also auxiliary parts are discussed in detail. The Upson-Walton Co.

WATER CONDITIONING

129 Feedwater Treating — Bulletin 1855, 30 pp, features manufacturer's hot process Accelerator for use in treatment of boiler feedwater, illustrating and explaining its operation and advantages, also optional auxiliary equipment. Contains excellent discussion of the necessity of treatment of makeup water, selection of proper equip-

MONEL { *A general-purpose, corrosion-resisting alloy for applications that require a hard, tough, high-strength material*

Monel® is a solid-solution alloy which combines high strength, ductility, fatigue strength, and toughness, with excellent resistance to corrosion. Its properties can be changed by cold working but it cannot be age hardened. It is slightly magnetic at room temperature and is non-magnetic above 110°-140°F.

The principal mechanical properties of Monel are:

● **Tensile Properties:** Hot-rolled Monel has a *minimum* yield strength (0.2% offset) of 25,000 psi., a minimum tensile strength of 70,000 psi., with an elongation (in 2 in.) of approximately 45%.

MECHANICAL PROPERTIES AND PHYSICAL CONSTANTS OF MONEL

MATERIAL	FORM AND CONDITION	AVERAGE MECHANICAL PROPERTIES				AVERAGE PHYSICAL CONSTANTS							
		YIELD STRENGTH (0.2% offset) 1000 psi.	TENSILE STRENGTH 1000 psi.	Elongation in 2 in. per cent	HARDNESS BRINELL	DENSITY lb./cu. in.	SPECIFIC GRAVITY	MELTING POINT °F.	Specific Heat (32°-212°F.) Btu./lb./°F.	Thermal Expansion Coefficient (32°-212°F.) 10⁶ in./in./°F.	Thermal Conductivity (32°-212°F.) Btu./sq. ft./hr./°F./in.	Electrical Resistivity (32°F.) ohms/cir. mil ft.	Tensile Modulus of Elasticity 10⁶ psi.
Monel (wrought)	Annealed	35	75	40	125	0.319	8.84	2370-2460	0.13	7.8	180	290	26
	Hot-rolled	50	90	35	150								
	Cold-drawn	80	100	25	190								
	Cold-rolled	100	110	5	240								
Monel (cast)	Sand-cast	35	80	35	135	0.312	8.63	2400-2450	0.13	6.8	180	320	19

● **Toughness:** Due to the coexistence of high ductility and high strength, Monel is one of the toughest alloys.

Charpy impact valves vary from 220 ft.-lb. for hot-rolled Monel, to 150 ft.-lb. for cold-drawn.

● **Spring Properties:** Monel spring wire can be used under corrosive conditions and at temperatures up to 400°F. For wire sizes heavier than 0.057-in. diameter, design of springs is based on a torsional modulus of 9,500,000 psi. and stresses of 45,000 psi. for average service, and 35,000 psi. for severe service.

● **Endurance Limit:** In rotating beam tests of polished specimens at room temperature and 10,000 r.p.m., Monel (cold-drawn, as-drawn) showed an endurance limit for 10^8 cycles of 40,000-47,750 psi.

● **Low-Temperature Properties:** Monel has excellent properties at sub-zero temperatures. Data shows that strength increases, without appreciable change in ductility, hardness or impact strength. Cold-drawn Monel at −110°F. had a tensile strength of 117,450 psi., a yield strength of (0.20% offset) of 100,850 psi., and charpy impact strength of 178 ft.-lb.

● **Working Characteristics:** Monel can be forged in practically any shape forgeable in steel. Recommended temperature for heavy-hammer forging and drop forging is 2150° to 1700°F. Hot working should be avoided in the range of 1700° to 1200°F. (If it is unavoidable, only light hot work should be done.) Monel behaves similarly to mild steel in mechanical cold working, as in cupping, drawing, swaging, die-forging, power hammering, bending and forming. Monel's high strength limits manual operations, such as spinning, bumping, and hand hammering, to easy shapes. Heavy work can be done by hand only with frequent anneals. Monel is satisfactorily machinable but due to its toughness, cutting speeds are somewhat slower and feeds lighter than those for mild steels. It can be joined by the usual welding, brazing, and soldering processes.

● **Corrosion Resistance:** Monel is highly resistant to attack by most commonly encountered corrosives, including neutral and alkaline salts, salt water, mineral acids, alkalies, organic acids and compounds, and wet and dry gases.

● **Forms Produced:** Monel is supplied in most commonly used mill forms—rods, hexagons, squares, rounds, flats, strip, sheet, seamless tubing, wire, welding materials—and in a variety of finishes and conditions. It is also produced in sand, centrifugal and precision casting.

FOR ADDITIONAL DATA

Write for your free copy of Technical Bulletin T-5, "Engineering Properties of Monel and 'R' Monel." It contains all essential engineering information on these alloys.

Nickel alloys are being increasingly diverted to defense applications. However, technical help for metal problems involving corrosion, high temperatures or fatigue is available from Inco's Technical Service, either for immediate defense needs or for future installations.

INCO **Nickel Alloys**

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York 5, N. Y.

MONEL® • "R"® MONEL • "K"® MONEL • "KR"® MONEL • "S"® MONEL
NICKEL • LOW CARBON NICKEL • DURANICKEL®
INCONEL® • INCOLOY® • INCONEL "X"®

ment. Also covers limitations of hot process softening. Infilco Inc.

130 What's New on Ion Exchangers — Here are three booklets covering company's ion exchangers: Nalcite HCR, a styrene type cation exchanger; Nalcite SAR, a strongly basic anion exchanger; and Super Nalcolite, a synthetic gel type zeolite for cation exchange. Tables and graphs explain performance of these water treating resins under various operating conditions. Physical characteristics, exchange capacities, regeneration techniques are discussed. Data is adequate for planning water treating installations. Bulletin 57, 20 pp, is on Nalcite SAR; Bulletin 58, 28 pp, on Nalcite HCR; Bulletin 59, 8 pp, on Super Nalcolite. State those wanted. National Aluminate Corp.

PUMPS, COMPRESSORS

131 Reciprocating Pump — Data Sheet 64A, 6 pp, describes manufacturer's recently developed 3-in. stroke direct flow triplex pump. Presents features of design and construction, dimensional drawings and performance data. Includes fluid-end and pump frame specifications. Lists industrial applications. The Aldrich Pump Co.

132 Rotary Pump Service Manual — Although written for users of company's own rotary pumps and including a parts list, this little 20-pp booklet contains tips on installation and care applicable to practically all pumps of this type. Covers mounting, pipe connections, suction lines, pipe sizes, strainers, discharge lines, power, relief valves, speeds. Provides pointers on noisy operation, rapid wear, decreased capacity and loss of suction. Viking Pump Co.

RODA

High grade gas, by-product, steam and household stoker coal from Wise County, Virginia, on the Interstate Railroad.

HENDRON

High grade gas, by-product, steam and domestic coal from Wise County, Va., on the Interstate Railroad.

STONEGA

High grade, high volatile steam and by-product coal from Wise County, Va., on the Interstate Railroad.

GLENBROOK

The Premium Kentucky High Splint unmatched for domestic use. Produced in Harlan County, Kentucky, on the L. & N. Railroad.

COKE

Roda and Stonega from Wise County, Va.

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High grade gas, by-product, steam and domestic coal—Pittsburgh seam from Irwin Basin, Westmoreland County, Pennsylvania, on the Penna. Railroad.

HAMPTON COAL

High volatile domestic, steam and by-product coal from Boone and Logan Counties, W. Va., on the Chesapeake & Ohio Ry.

CROZER

Genuine Pocahontas from McDowell County, W. Va., on the Norfolk & Western Railway.

LYNCO

High fusion coking coal for by-product, industrial stoker and pulverizer use from Wyoming Co., W. Va., on the Virginian Ry.

ANTHRACITE

Hazle Brook—*Premium Lehigh*
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Capable engineering personnel and the experience gained through long and varied marketing activity assure proper application of one of the above brands and effective servicing of any fuel requirement.

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CABLE ADDRESS, GENCO

BRANCHES:

BLUEFIELD, W. VA. BUFFALO CHARLOTTE, N. C. CINCINNATI
NEW YORK NORFOLK PITTSBURGH

133 Controlled Volume Pumping — Illustrated Bulletin 151, 24 pp, on controlled volume pumping will be of interest to engineers whose plant operations call for pumping a controlled volume of liquid in amounts from 3 ml per hour to 50 gpm. Describes features of company's pumps and includes data for selecting pumps for specific applications. Colored reference charts show in "stop-go-caution" style the relative corrosion resistance of construction materials to over 170 chemicals. Milton Roy Co.

134 Condensate Return Units — Catalog Section 212, 6 pp, features an easy-to-use selection table covering company's vertical condensate return units. It gives EDR sq ft, capacity in gpm, receiver capacity in gallons, and range of models according to boiler pressure. Also describes in detail this new vertical design, which is particularly intended for installation where return piping is close to floor level. Roy E. Roth Co.

135 Steam Heating Pumps — Twenty-pp of information on vacuum and condensate pumps are presented in Bulletin 1401. Covers vacuum pumps from 2500 to 65,000 EDR, providing an illustrated description of vacuum pump operation, detailed data on working parts, a table showing standard air and water capacities, rating and testing procedures, diagrams of sample installations and dimensions. The section on condensation pumps, ranging from 2000 to 50,00 EDR, describes advantages for rapid return of condensate to low pressure boilers. Illustrates operation, gives capacity tables. C. A. Dunham Co.

136 Care of Pumps and Fittings — Planned Maintenance Manual 2, covering company's Flexflo pumps, valves, fittings and tubing, is an excellent 12-pp how-to-do-it booklet. Discusses correct installation, proper operation, adequate check-ups and cleaning. It's fully illustrated with photos and sketches and includes a check list trouble-shooting chart listing nature of trouble and items to be checked to remedy the condition. Cherry-Burrell Corp.

137 Blowers and Compressors — Bulletin 0500, 62 pp, just released, contains comprehensive data on three types of centrifugal blowers and compressors: multi-stage; single stage end suction, and single stage double suction. Capacities from 1000 to 150,000 cfm for pressures to 150 psi and above are covered. Arranged in four sections, the first provides application data for blast furnace and Bessemer converter blowers, process industry uses, high pressure natural gas transmission, gas compressor or booster services, air for combustion, agitation, and other services. Another section is on design and construction. Steam turbine and motor drives are covered in the third section and the fourth provides engineering data including curves, formulas and examples for computing compression of gases and pipe friction. De Laval Steam Turbine Co.

138 Heavy-Duty Compressors — Bulletin 222, 8 pp, is on manufacturer's Type BPPE heavy-duty, slow-speed, water-cooled variable volume compressors for compressing air and gases to pressures from 70 to 500 lb. Cross-section diagrams in color show construction and operation features. Also described is company's Quiet-Tite valve. Bury Compressor Co.

METALS

139 Thin Electrical Steels — New test data and information are presented in this 36-pp booklet to permit selection of thin electrical steels for high frequency equipment without theoretical determinations, extrapolation of meager data or use of empirical formulas. Representative test results are shown in 21 pp of curves giving magnetic properties of three iron-silicon alloys — a non-oriented grade, an oriented alloy, and a super oriented grade. Curves show core loss, exciting rms volt-amperes per poud, a-c permeability, induction versus frequency, figure of merit and lamination factor. Armco Steel Corp.

140 Corrosion Resistance of Copper — The results of 25 years of research into the nature of corrosive attack on copper

a sure way to cut maintenance costs!

● That's right. Republic's Champion Air Hose will cut a big chunk out of your maintenance costs . . . relieve you of many a maintenance worry.

It's a fact, proved over and over again under the toughest conditions possible.

You see, Republic's Champion is a top-quality, braided hose, combining ruggedness with extreme flexibility and light weight. It's built with a smooth, friction-reducing, oil-resistant inner tube, surrounded by multiple braids of specially processed, chemically strengthened yarn. Its thick, armorlike safety cover wards off destructive blows from falling objects . . . stands firm against abrasion and wear.

Champion Air Hose, with the yellow safety cover, is available in braided, mandrel-cured construction in 50-foot lengths.

Your local Republic Distributor can help you choose the right hose for your job. Consult the yellow pages in your telephone directory for his name or write direct for information.

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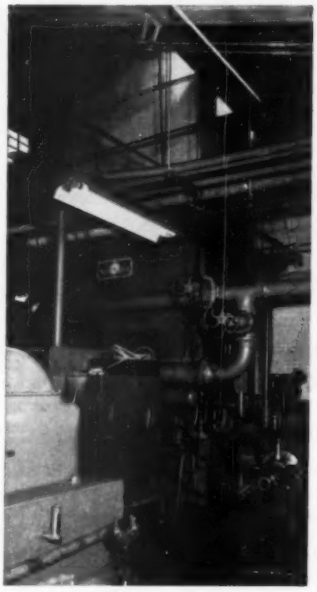
You Get Trustworthy Liquid or Gas Cooling With Great Cooling Water Savings from the NIAGARA AERO HEAT EXCHANGER

● You can cool air, gas, water, oils, chemicals, electric and power and process equipment, engines, mechanical processes with lower cost and really accurate control of temperature with the Niagara Aero Heat Exchanger.

You are assured of uniform, constant production and quality from any process . . . steady, reliable operation . . . lower cost for more dependable cooling. You can have closed system cooling with freedom from scale, dirt, corrosion and maintenance troubles. You can accurately cool more than one type of liquid with one machine.

The Niagara Aero Heat Exchanger uses atmospheric air to cool liquids and gases by evaporative cooling. You can remove heat at the rate of input to keep accurate control of gas or liquid temperature. You can put heat back into the system to save the losses of a "warm-up" period or to equalize the effect of load variations.



Great savings in cooling water and savings in piping, pumping and power return the cost to you quickly. The Niagara Aero Heat Exchanger can save you approximately 95% of your cooling water cost. Write for Bulletin 96.

NIAGARA BLOWER COMPANY

Over 35 Years Service in Industrial Air Engineering

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Experienced District Engineers in all Principal Cities

and copper alloys are published in 24-pp Publication B-36. Explains chemical and physical nature of corrosive attack in various forms. Includes tabulation indicating relative corrosion resistance of principle types of copper and copper base alloys when in contact with 183 corroding agents. Also lists typical industrial uses of these metals; gives composition, available forms and physical properties of company's standard coppers, bronzes, brasses, other alloys. Anaconda Copper Mining Co.

PACKINGS

141 Abestos Packings — This 8-pp illustrated bulletin describes and gives service recommendations for braided and twisted asbestos packings. Covers twisted valve stem, braided valve stem, high temperature valve stem, braided round and squared, square plaited braid, oil-resistant and braided blue packings. Lists standard sizes, specifies packaging, and gives approximate weights of the several types. Packing Div., Raybestos-Manhattan, Inc.

142 Duck and Rubber Packings — Various types of duck and rubber packings, including low pressure, cross expansion, hydraulic, hollow core, round rubber core and diagonal expansion types, are described in this 8-pp illustrated bulletin. Gives complete service recommendations for each type, lists standard sizes, and gives packaging specifications. Packing Div., Raybestos-Manhattan, Inc.

STOKERS

143 Where Refuse Is Fuel — Presented in 24-pp Bulletin are installations of company's RotoGrate stokers with medium-size and larger units burning refuse fuels, separately or in combination with coal. Lists many of the refuse fuels handled successfully by this type of spreader stoker. More than 20 such installations are described, illustrated by drawings and photos. Detroit Stoker Co.

144 Stokers Classified — Spreader and underfeed stokers with various types of grate arrangements are presented in this 8-pp booklet. Illustrated with photos and sectional drawings, text is brief but to the point. Tells best applications and special advantages of each type of stoker, gives size and capacity ranges. Stoker Dept., Westinghouse Electric Corp.

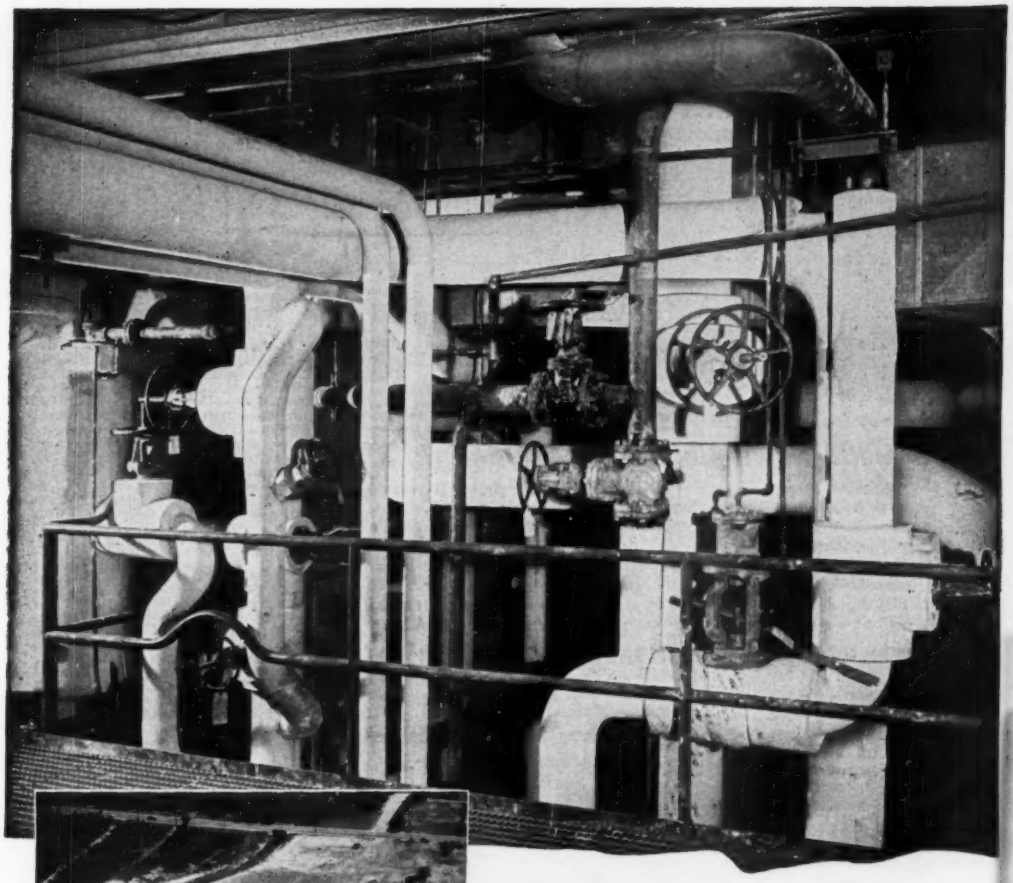
OTHER EQUIPMENT

145 Open-Steel Floors — "Versatile Open-Steel Flooring" is a 16-pp idea book profusely illustrated with installation photos showing many and varied possibilities for using steel grating inside the power plant, in refineries, for outdoor catwalks and stairways etc. Explains types and features of this flooring and specifications for insuring quality flooring and its proper installation. Open Steel Flooring Institute, Inc.

146 Industrial Burners — General Bulletin 751 describes and pictures company's gas-oil burner equipment for a wide range of applications and includes photos of many installations. Equipment covered includes several types of burners, control equipment, combustion units, fuel oil pumping and heating units. National Airoil Burner Co., Inc.

147 Magnet Selection Guide — Twelve-pp illustrated Catalog C-5000-B, describing manufacturer's entire line of magnetic separators and lifting magnets serves as a handy guide to the selection of magnets from the application standpoint. Tells which magnets to use to remove iron from wet or dry materials carried on conveyor belts, as well as from chutes, ducts. Units for magnetic concentration and purifications, heavy media recovery and materials handling are also discussed. Dings Magnetic Separator Co.

148 Economy of Steam in a Package — Illustrated Bulletin ID-51-115 shows



WITH NAVCO PIPING *Results* ARE PRE-ASSURED

Navco's high degree of engineering skill and use of the most modern plant and field facilities are your guarantee of a long lasting and trouble-free piping system.

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Paracoil EVAPORATORS

for STATION HEAT BALANCE or FRESH WATER SUPPLY

Shop View of SALT AND FRESH WATER EVAPORATORS built by PARACOIL for San Juan Steam Electric Station, Porto Rico Water Resources Authority, San Juan, Porto Rico. Jackson & Moreland, Boston, Mass., Consulting Engineers

HERE'S A JOB WE'VE BUILT FOR SAN JUAN, P. R.

Wherever pure water is needed for boiler feed makeup, process work or general plant operation, a PARACOIL EVAPORATOR is a proven, time-tested means of handling any kind of initial raw water—salt or otherwise.

They are ruggedly built—dependable—and easily maintained. Specific requirements dictate the design. Our years of experience in building units of this type—and other power plant apparatus—assures you of the correct solution to your problem. *We invite your inquiry.*

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4 WAYS TO CUT THOSE PUMP REPAIRS

Sims valves are made in sizes from 2¾" to 15¼" to fit any reciprocating pump. Valves supplied ready to install—cast in individual units or in complete plates.

1. **Prevent STEM and SPRING breakage.** Exclusive double shock absorber built into Sims valves stops impact shock.
2. **Stop wear.** Long guide of ROTATOR prevents cocking of DISC—assures even opening.
3. **Keep seating surfaces lock free.** Only Sims guarantees the valve DISC will rotate every time it lifts.
4. **Stop valve slam and knock.** Quiet operation is gained by cushioning moving parts and cutting resistance to flow through the SEAT... with patented **inclined ribs.** This reduction of resistance allows cylinders to fill completely. Pump capacity is increased 20%.

SIMS PUMP VALVE CO., INC.

New catalog shows how Sims valves fit any pump—how they work—efficiency and comparison charts. Send for your free copy today.

145 HUDSON ST., NEW YORK 13, N. Y. • M & M BLDG., HOUSTON, TEXAS

how packaged steam generators save money where heat and power are needed. Details manufacturing, installation and operating advantages. Discusses boiler construction, special design features. Also covers sizes available, specifications and ratings, wide range of fuels possible and approvals by ASME, other authorities. York-Shipley, Inc.

149 Power Plant Equipment Guide — Twelve-pp Bulletin S-196-S, describing in condensed form company's line of power plant equipment, is profusely illustrated with photos, flow diagrams, dimensional drawings, performance charts and specification tables. Describes control valves, pressure master controls, desuperheaters, temperature master controls, water regulating valves, liquid level and drainage controls, differential pressure controls, feedwater heaters and regulators, separators, exhaust heads, other accessories. Punched for filing in three-ring binder. The Swartwout Co.

150 Higher HP Diesel — Design, operation and engineering data on company's Supairthermal diesel are given in 12-pp Bulletin 191. Illustrated by indicator diagrams and piston-stroke comparison, tells how this engine achieves ability to produce in any given size one-third more horsepower than most turbocharged engines. Discusses engine's advantages, contains diagrams of more common types of cooling systems applicable to it and presents a nomogram for determining BMEP rating for the engine under typical operating conditions. Also shows models available in four-cycle types, in sizes from 425 to 3200 Bhp. Nordberg Mfg. Company.

151 Ordering Guide for Tools — Catalog TR, just released, covers manufacturer's complete line of over 4000 tools. Contains 104 pp of information on all types of socket wrench equipment, hand tools and wrenches, punches, chisels, screwdrivers, pliers, tool boxes and related tools for servicing operations and maintenance work. Features large illustrations of all types of wrenches with copy keyed for easy identification. As complete specifications are included, it's easy to find exactly the tool needed for a particular job. Snap-on Tools Corp.

152 Silica Cement — This bulletin describes a super-duty silica cement for use in laying silica refractories. This heat-setting cement corresponds in refractoriness and in chemical and physical properties with quality silica brick and is recommended for poured or trammeled joints. Includes photos showing results of comparison tests between company's Vega Bond and other silica cements, including effects of heat treatment, refractoriness, trowelling and settling. Harbison-Walker Refractories Co.

153 Mounting Felt — An easy way to choose the right grade and weight of vibration mounting felt is described in "How to Reduce Vibration," 20 pp. This little booklet explains economy of good felt, tells how it absorbs vibration, where it's used to advantage. Includes list of engineering data sheets available on felt. American Felt Co.

154 Isometric Drawing Simplified — Bulletin V-14, 8 pp, introduces the Vibax, a drafting machine designed to automatically produce isometric and dimetric views by tracing over lines of standard orthographic drawings. Explains and illustrates how Vibax is used, gives specifications. Stresses faster production by trained isometricians, use by draftsmen without isometric experience. Indamer Corp.

155 Instantaneous Water Heaters — Twelve-pp Catalog 60 features instantaneous water heaters and other industrial fluid heating units, giving their advantages and illustrating typical installations. Includes useful sizing data, steam consumption tables and diagrams. General Fittings Company.

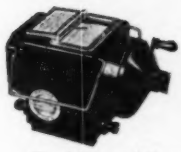
156 Lightweight Metallizing Gun — Bulletin 95 introduces manufacturer's Type 5E metallising gun designed for spraying 3/16 in. wire and weighing only 4¾ lb. Design features are described, illustrated by cutaway drawing. Metallizing Engineering Co., Inc.

BIDDLE
Instrument News

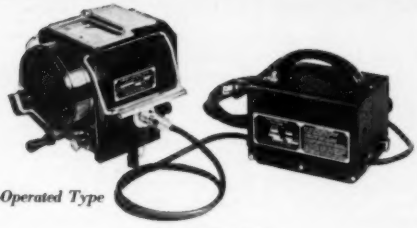
- ELECTRICAL TESTING INSTRUMENTS
- SPEED MEASURING INSTRUMENTS
- LABORATORY & SCIENTIFIC EQUIPMENT

NUMBER 10 OF A SERIES

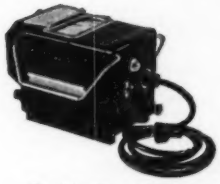
JAMES G. BIDDLE CO., 1316 ARCH ST., PHILADELPHIA 7, PA.



Hand-Operated Type



Dual-Operated Type



Rectifier-Operated Type

MEGGER® ELECTRICAL INSULATION TESTERS in Types to Suit Varying Needs For Shop and Field

There's a Megger instrument to suit any set of conditions in shop or field, or a combination of both. The types shown here were born out of the actual experiences and requirements of practical electrical engineers and maintenance men, who found in the James G. Biddle Co. a personal interest in their electrical insulation checking problems.

The Hand Crank Meg Type of Megger Insulation Tester is a reliable field instrument, light, sturdy, with constant-voltage type generator—no dependence on batteries or other current supply. Ranges to 2000 megohms, hand generators to 1000 volts d-c.

The Rectifier-Operated Meg Type of Megger Insulation Tester covers the same ranges as the hand crank model. It is most efficient for bench work—long tests or repetitive tests of a "production line" nature because it operates from a built-in rectifier that plugs into a convenient outlet.

The most versatile of the Megger family of instruments is the *Dual-Operated* Meg Type of Megger Insulation Tester. This can be a field instrument with hand crank, or instantly converted into a rectifier-operated instrument by handy plug-in rectifier connected to 115 v. 60 cycles outlet. Same ranges as other Meg Types.

For a complete picture of the Biddle line of Megger Instruments write for Bulletin 21-05-PE.

IDEAL INSTRUMENT FOR GROUND RESISTANCE TESTS "OUT IN THE FIELD"

Meg Type of Megger® Ground Tester

A high-quality, rugged instrument that gives reliable ground resistance readings even in the hands of work crews and test men who are not experts in electrical instruments. It is direct-reading in ohms requiring no calculations. It has one set of connections for 3-terminal or 2-terminal tests, and an unfailing hand generator power source. Unaffected by stray current in the earth, or by polarization or electrolysis. The Meg Type of Megger Ground Tester is accurate to within 1/32 of an inch along its scale.

Available in 5 range scales from 0-300 to 0-3000 ohms. Furnished complete with test leads and reference ground rod. Dimensions of instrument are 5" x 9¼" x 6¼". Weighs about 8 lbs.

We shall gladly furnish to responsible prospects the names of companies who have adopted these handy instruments for field crews. Write for list "P E" . . . also Ground Tester Bulletin 25-PE, and "Grounding Electric Circuits Effectively" by J. R. Eaton (Bulletin 25T2-PE).

ON GETTING FLOOD-SOAKED ELECTRICAL EQUIPMENT BACK INTO SERVICE

During July the nation's interest shifted from the tides of war to the floods in Kansas and Missouri. The threat of this major catastrophe to the nation's emergency production program assumed staggering proportions. For most of us this whim of Nature was only a newspaper or newsreel story which didn't affect us directly at all. But for those in the path of this destructive inundation it meant untold hardship and property damage.

The task of restoring order and setting the wheels of industry in motion is a story in itself. The electrical men, and readers of Biddle Instrument News can well appreciate what would happen in their own plants if all motors, generators, transformers, and starting and control equipment became covered with water and dirt for days and weeks on end. The clean-up and dry-out job would be terrific.

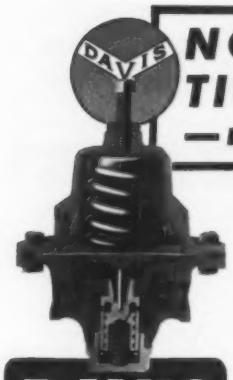
The electrical supply houses and electrical maintenance and repair shops assisted tremendously in helping to restore order out of chaos. The Westinghouse Corporation for example used full pages in the Kansas City Star to bring their "Guide to Flood-Time Care of Electrical Equipment" to Industrial Management. In our own case, we had Megger Insulation Testing Instruments on their way two and three hours after the emergency calls were received.

Floods Not the Only Enemies of Electrical Equipment

The proper care of electrical equipment, or electrical preventive maintenance, is a year round job. Dirt and moisture in any form must be combated month in and month out. Dependable instruments for testing insulation at regular intervals are a must if the records of the condition of electrical equipment are to mean anything.

Among electrical men in industry the Megger Insulation Tester ranks high. Most men think of the Megger Instruments when they think of electrical insulation resistance testing.

NOTE: ***Readers of Biddle Instrument News can obtain information on "Tests When Drying Out Wet Apparatus" from our Megger Instruction Manual 21-J-PE. If you do not have a copy write to us for one.***



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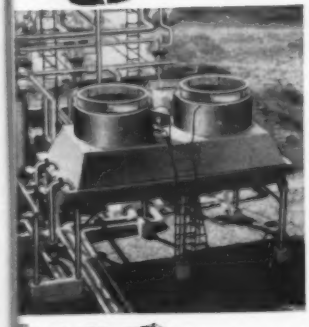

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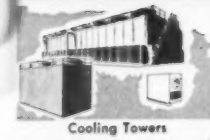

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CATALOG LIBRARY

(Continued from page 50)

278 Coal Scale — Bulletin 0250, 12 pp, describes a pressure-tight, automatic coal scale, its construction and operation. Shows how beam system, electrical components and linkages are protected from exposure to coal dust. Richardson Scale Co.

279 Efficient Coal Preparation — Facts on improved coal preparation for power plants are presented in this 8-pp illustrated booklet. Shows how coal is split, not crushed, by rolling ring principle utilized in company's equipment to provide better combustion and reduced ashpit loss through uniform low-cost coal sizing. American Pulveriser Co.

280 Spreader Stoker — Bulletin 890, 40 pp, describes a spreader stoker with overthrow rotor designed to provide uniform fuel distribution. Discusses advantages, including efficiency in burning many grades of coal and handling fluctuating loads. Power-operated and hand-operated dumping grates, stationary grates shown. Detroit Stoker Co.

281 Ash Handling Systems — This 24-pp booklet offers technical information on hydraulic and pneumatic ash and fly-ash handling systems. Compiled in question and answer form. Discusses elements and advantages of various systems and disposal schemes. Schematic drawings of arrangements under specific conditions, diagrams of arrangements included. Beaumont Birch Co.

282 Coal Handling Equipment — Modern equipment for the storage and handling of coal and ash is presented in 24-pp Bulletin 300. Illustrated, covers concrete and tile silos, cylindrical steel tanks, suspended steel bunkers. Gifford-Wood Co.

COMMUNICATIONS

283 Power Plant Communication Systems — This 25-pp brochure describes a high and low level intercom system designed and built especially for power plants — a system readily installed and permitting two-way conversations over close-speaking microphones and receivers as well as paging over loudspeakers suited to different noise levels. Gai-Tronics Corp.

PUMPS AND COMPRESSORS

284 Compressor Selection Chart — Based on normal applications handling air with atmospheric intake pressure, this chart simplifies selection of proper size compressor, giving quick comparison between discharge pressure pounds per square inch gage and piston displacement cubic feet per minute. Shows recommended compressor bore and stroke in inches. Worthington Pump and Machinery Corp.

285 Boiler Feed Pumps — Bulletin 109, 16 pp, illustrated in color, describes centrifugal pumps for boiler feed service. Pictures construction and major parts, floating seal incorporated. Capacity data, vapor pressure tables included. Pacific Pumps, Inc.

286 Pulsation-Free Compressor Piping — Illustrated Bulletin PDS-8501, describes company's pulsation dampening piping system. Tells how this piping affords higher operating efficiency, other advantages. Explains pulsation phenomena in compression systems. The Fluor Corp., Ltd.

287 Data on Pumps — All Types — Bulletins are available on centrifugal, reciprocating, screw and rotary pumps covering a wide range of capacities and services. Includes information on single and multi-stage, close coupled, single and duplex piston, and special pumps for handling erosive and corrosive liquids, also high viscosity liquids, both lubricating, non-lubricating. Warren Steam Pump Co., Inc.

HEATERS, HEATING

289 Water Heaters — Illustrated 6-pp Bulletin 70, Section I, on instantaneous type water heaters contains detailed capacity and dimension tables for two-, four- and six-pass designs, with tube bundles removable. Davis Engineering Corp.

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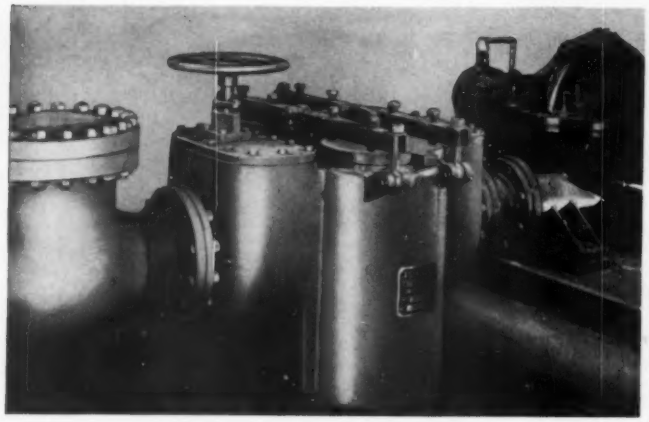

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290 **Heat Exchangers** — Bulletin 114, a small folder, gives concise information on company's Aero heat exchanger with balanced wet bulb control designed to cool engines or process equipment, coolants and lubricants, liquids and gases for processing operations. Niagara Blower Co.

291 **Heat Exchangers** — Bulletin 11.0.-080 describes air cooled heat exchangers for condensing or cooling of steam or process vapors, natural gas, jacket water, lubricating oil, quenching baths. Equipment Div., J. F. Pritchard & Co.

COOLING

292 **Cooling Towers** — Bulletin AQ-50 is on packaged water cooling towers in 3 to 50 t sizes. Gives specifications for the tower and discusses special features. Also provides dimensional and application data covering the five standard and three large sizes. The Marley Co., Inc.

293 **Spray Nozzle Systems** — Recooling spray nozzle systems for use in plants operating condensers or using large quantities of water for cooling, are covered in 8-pp Bulletin 6A-8P. It details design, application, construction, and operation of spray nozzles, and diagrams typical spray pond arrangements. Sizes, dimensions, capacities, and spray nozzle patterns are included in tabular form. A temperature graph gives cooling performance curves for spray nozzles for various temperature ranges using 7 psi at nozzle. Schutte and Koerting Co.

294 **Cooler with Fins** — A new oil and water cooler and advantages of its improved design are described in 20-pp Bulletin 1020. Explains how company's LK-Fin Cooler, distinguished by use of helically-finned heat transfer elements instead of bare tubes, is a lighter, more compact and less costly unit. Diagrams show comparisons of length and number of tubes and size of units for equivalent heat transfer surface. The Griscom-Russell Co.

DUST CONTROL

295 **The Efficiency of Decantation** — The decantation principle as applied in dust control systems and how it separates high carbon content particles from fly ash for re-injection as fuel is discussed in illustrated Catalog 260D. A typical installation is diagrammed and efficiency curves included. The Thermix Corp., Prat-Daniel Corp.

296 **Fly Ash Elimination** — This 30-pp booklet presents manufacturer's "Multiclone" equipment (described as small-tube type of cyclonic dust collectors using centrifugal force for separating dust from gas stream) as a highly successful and economical means of separating fly ash — not as a panacea for all cinder and fly ash problems. Also gives data on single and double hopper installations. Western Precipitation Corp.

297 **Dust Collecting Efficiency** — How the higher and narrower inlet utilised in company's tubular dust collector improves dust collecting is explained in this illustrated bulletin. Prat-Daniel Corp.

FANS, BLOWERS

298 **Mechanical Draft Fans** — Mechanical draft fans for both forced and induced draft service are described in 20-pp Bulletin 168. Illustrated with drawings of typical fan types and photos of installations, includes performance curves showing efficiencies of various types of fans. Gives construction features, drive arrangements, mounting methods. The Green Fuel Economiser Co., Inc.

299 **Blowers and Accessories** — Engineering and dimensional information on low, medium and high capacity blowers is given in this 6-pp bulletin. Pictures some installations, also accessories. Blower-Stoker Div., Read Standard Corp.

300 **Axial Flow Blowers** — In this 6-pp illustrated bulletin are described axial flow blowers of both turbine-driven and motor-driven types. Gives capacity and di-

(*Continued on page 154*)

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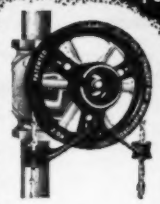

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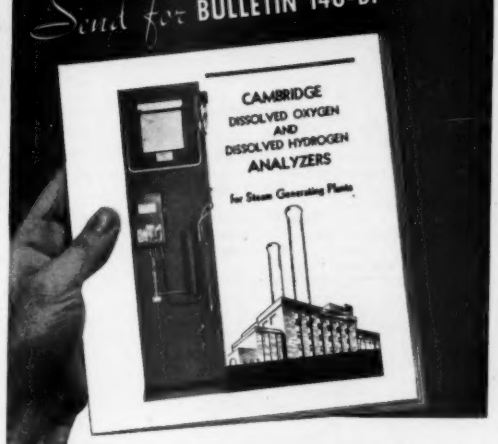

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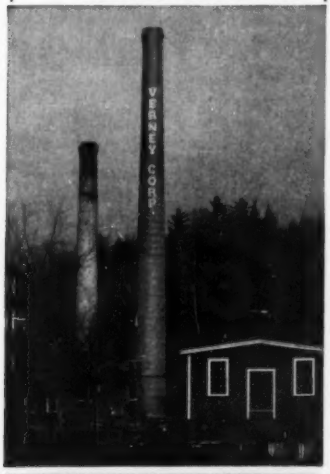

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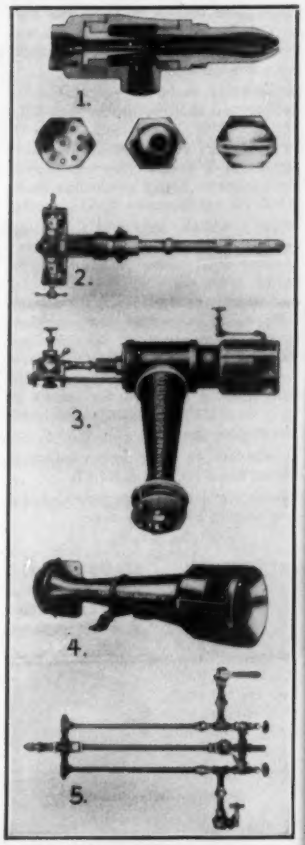

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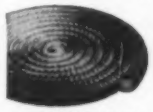

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(Continued from page 130)

mensional data, operating range and specifications on both types. L. J. Wing Mfg. Co.

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302 Steam Condensers with Reserve Flow — Eight-pp Catalog 410-1 describes a "self-cleaning" reverse-flow condenser for power plant service, designed to virtually eliminate cleaning down time and, in the case of divided water box condensers, eliminate operation at partial load. C. H. Wheeler Mfg. Co.

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304 Steam Condensers — Bulletin 102, 24 pp, presents manufacturer's steam condensers and includes photos of typical installations as well as engineering data, discussion of air removal equipment, and chapter on condenser maintenance. Company's Wizard injector to seal small leaks while condenser is in operation, air erosion eliminators, divers lights and port gages are also described. Condenser Service & Engineering Co., Inc.

METALS

305 Steels for Hot Spots — This is an 88-pp manual on steels for elevated temperature service. Includes a discussion of the general principles of high temperature behavior of ferrous materials and the factors influencing their behavior; a data section replete with tabular and graphical material covering mechanical properties of 21 steels. United States Steel.

306 Bibliography on Nickel Alloys — Sixteen-pp List A covers company's technical papers and commercial publications available on nickel alloy steels, stainless steels, nickel cast irons, nickel brasses and bronzes, and nickel plating, and their uses. The International Nickel Co., Inc.

OTHER EQUIPMENT

307 The ABC of CO_2 — An interesting text covering role of carbon dioxide in combustion efficiency, 16-pp illustrated Bulletin 452 discusses theoretical vs practical perfection of combustion and tells how to determine percentage of CO_2 in flue gases. CO_2 as a basis for figuring heat and fuel losses is also described and method of determining such losses explained. Includes scales of total heat losses of various types of coal, fuel oils and gas. The Hays Corp.

308 Transmission Belting — Catalog M-9922, 28 pp, gives design, engineering and performance data on transmission belting. Tables on belt speeds, arc of contact, friction, horsepower correction, and service factors included. United States Rubber Co.

309 Turbine Catalog Collection — This is a valuable collection of bulletins covering a complete description of solid wheel turbines. They feature cross section drawings of typical units for both moderate and high steam pressure conditions. Includes data on speed increasing and reduction gears. The Terry Steam Turbine Co.

310 Paints to Beat Corrosion — This 8-pp illustrated bulletin on anti-corrosive paints discusses their sub-oxide of lead base and other technical properties and points out economy of these rust-inhibitive coatings. Describes primers, finishing coats and single coats available; tells how to apply them. Also discusses painting of galvanized structures. Subox, Inc.

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312 Industrial Insulations — Selection and application information on insulating materials is presented in this 28-pp illustrated catalog. Covers block and blanket insulations, insulating cement, low pressure coverings, felt, other products. Gives specifications, temperature ranges, recommended thicknesses, prices; tells how to apply each type, where to use it. Baldwin-Hill Co.

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315 Fundamentals of Hydraulics — Technical Bulletin B-4 is a newly revised 44-pp guidebook covering essential information on hydraulic systems, maintenance trouble-shooting and selection of proper fluids. Besides offering reference data to engineering personnel, this book is suggested as a training manual for maintenance supervisors, operators. It features specially prepared phantom and cutaway drawings illustrating functions of basic types of valves, pumps, hydraulic motors, torque converters. Sun Oil Co.

316 Steam Atomizing Oil Burners — Sixteen-pp illustrated Bulletin 21 describes steam atomizing oil burners and auxiliary equipment for use with heavy oil or tar in boilers, stills, dryers and other furnaces, where steam or compressed air is available for atomizing the oil. Discusses steam and oil control valves, design and construction of furnaces in which fuel oil is burned, register and tandem types combustion units. National Airoil Burner Co., Inc.

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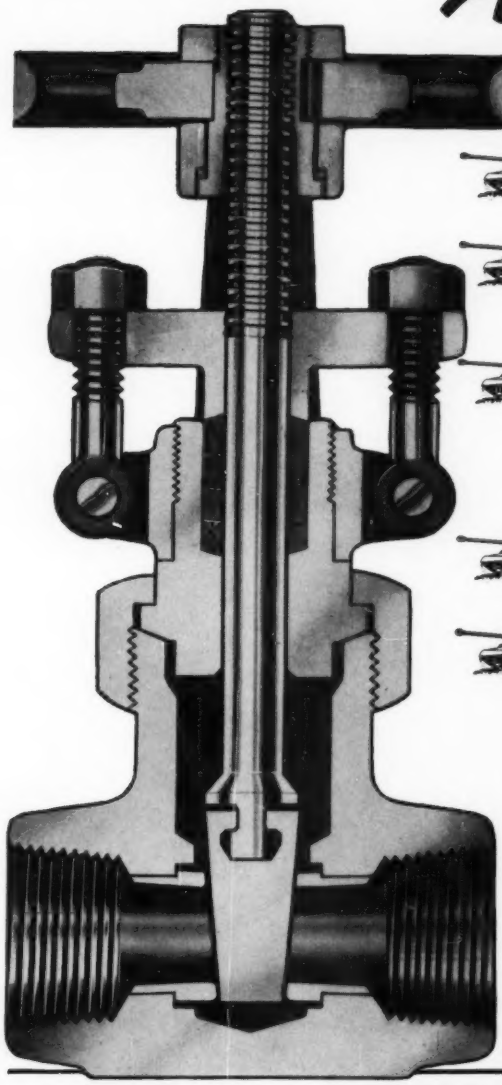

Body and Yoke are of Forged Steel, for extra strength and longer life.

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with no follower threads on yoke to corrode. Follower easily tightened down any time when necessary.

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When furnished with either 12-14% or 18-8% stainless steel trim, List 960's gates are hardened by "Malcomizing," patented Chapman process. "Malcomizing" hardens to a minimum of 800 Brinnell, which minimizes seizing or galling and lengthens valve life.

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Chapman List 960 is available in sizes from ¼" to 2" . . . in four different alloy-combinations of body and trim which qualify this rugged forged gate valve for many different services. Gasketed joint, or metal-to-metal. Rising stem with yoke (shown) or rising stem inside screw. Pressure range: 2000 lb. at 100°F.—380 lb. at 1000°F. (for higher pressures, specify List 990). Write for illustrated fact-sheet on List 960.

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The Chapman Valve Manufacturing Company
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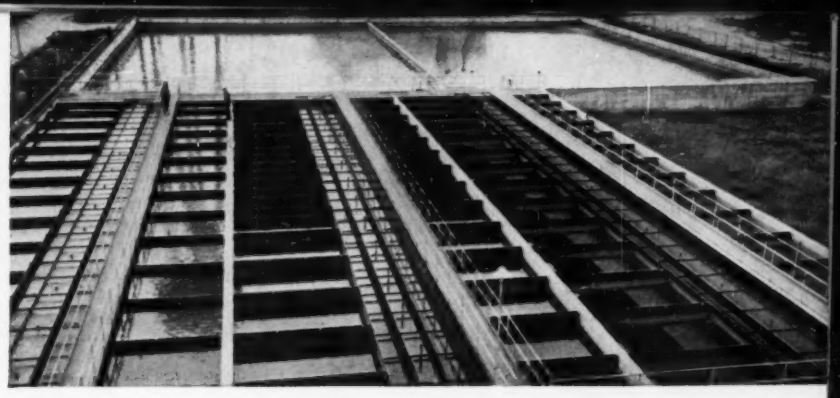
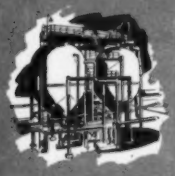


Three Permutit Precipitators at Alcoa's Davenport, Iowa plant. Each processes 3,000,000 gallons of water a day.

How Permutit helps Alcoa get BETTER WATER...

THESE BASIC PROCESSES, PLUS PERMUTIT SKILL, CAN SOLVE YOUR WATER CONDITIONING PROBLEMS



1. SLUDGE BLANKET HOT LIME SODA. Application of the sludge blanket to hot lime soda treatment reduces silica in boiler feed make-up, produces high quality steam.

2. HOT ZEOLITE—PERMUTIT Q. Subsequent treatment of water from hot lime soda treatment yields effluent of zero hardness. Permutit Q, or styrene base mineral resistant to high temperatures, replaces second stage phosphate treatment.

3. SILICA REMOVAL PLUS DEMINERALIZATION. Demineralization by cold ion exchange processes produces water comparable to distilled water only at a fraction of the cost of distillation. Treatment by anion exchange resin, Permutit S, reduces silica to less than 0.2 ppm.

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5. PRECIPITATOR. The Permutit Precipitator is used to lower alkalinity, reduce hardness, and help to remove turbidity, color, taste and odor. It can also be used to reduce silica.

with

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LOW OPERATING COST
LOW CHEMICAL COST
LOW WATER WASTE

Alcoa's water needs average 9,000,000 gallons per day in their Davenport, Iowa plant. A Permutit Precipitator processes all their mill use water, and yields an effluent turbidity of only 5 ppm from an influent turbidity as high as 900 ppm. Yet operating cost, including pumping, chemicals, depreciation and maintenance, is only 5¢ per thousand gallons. Of this, chemical cost is less than 2¢ per thousand. Water waste has averaged only 8.75%.

Precipitators for lowering alkalinity and removing turbidity of water are only one of many Permutit products for solving water conditioning problems. In the column at left, some of the more important basic processes are illustrated and described.

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